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CONTENTS

PAGE

Rymer Roberts, the late A. W. On the taxonomy of Erotylidae (Coleoptera), with special reference to the morphological characters of the larvae. II . . . . 245–285, 49 figs.

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ON THE TAXONOMY OF EROTYLIDAE (COLEOPTERA), WITH SPECIAL REFERENCE TO THE MORPHOLOGICAL CHARACTERS OF THE LARVAE. II

By the late A. W. Rymer Roberts[1]

(Read 6th November, 1957)

Manuscript received 10th April, 1957

With 49 Text-figures

Contents

		PAGE
I.	Introduction and Acknowledgments	245
II.	Dacninae Fowler	246
III.	Triplacinae (= Tritominae Arrow)	253
IV.	Erotylinae Ganglbauer	261
V.	Analytical Keys	275
	(A) The discrimination between larval Cryptophagidae and Erotylidae	275
	(B) Analytical key to the subfamilies and genera of larval Erotylidae	276
VI.	References	283
VII.	Notes on the Figures with Explanation of Lettering	284

I. Introduction and Acknowledgments

[In 1939 A. W. Rymer Roberts published the first part of this paper in Volume 88 of these *Transactions* (pages 89–118). On page 92 he referred to an analytical key to be published in the concluding part of the paper. Unfortunately various other preoccupations prevented my late friend from finishing this work. Through his kindness and that of his wife, the late Mrs. Ruth Roberts, I received his entomological notes and manuscript. I was especially glad to find among them the following descriptions of Erotylid larvae, which required only minor additions, mostly in accordance with queries indicated by Rymer Roberts in the margin. These additions, like all other notes and alterations made by me, have been placed in square brackets. It is not known whether it was originally intended to describe all the available genera of Erotylid larvae, but Roberts was obviously in the main interested in the major classification and definition of the family, and it is probable that the descriptions were to give the morphological background for these taxonomic aims, based on a representative number of genera. Thus, although he knew since 1934 that larvae of the Languriine

[1] Deceased 9th April, 1955. Obituary notices in: *Ent. mon. Mag.* **91**: 168, 1955; *Proc. R. ent. Soc. Lond.* (C) **20**: 75, 1956; *Beitr. Ent.* **5**: 667, 1955; *J. Proc. Linn. Soc. Lond.* **167**: 138–9, 1957.

genus *Acropteroxys* are preserved in the U.S. National Museum, his 1939 paper does not mention this genus in dealing with that subfamily. A plan of Part II, the present paper, contains a list of the completed descriptions and those still to be completed. This plan refers only to one genus and species not treated in the following descriptive part. It is the genus *Ischyrus*, which was included in the plan with a query. Except for a rough camera lucida sketch of the ventral mouthparts, no drawings or drafts on this genus were found, and it is assumed that Rymer Roberts decided not to include a description of the larva of this genus.

The notes do not contain a draft to the analytical key but only a table of the main characters of the genera treated in 1939, most of those treated in the present paper, and some genera studied for comparative purposes, e.g. *Penthe*, *Byturus* and others. Therefore, the analytical key found at the end of this paper has been drafted by me on the basis of the 1939 paper, the descriptions in the present publication, a number of tubes with larval material deposited in the British Museum (Natural History), the microscope slides made by Rymer Roberts, a set of notes and sketches sent to him by Dr. A. G. Böving, the literature and my own material and notes. The thanks of A. W. Rymer Roberts and myself are due to the late Dr. A. G. Böving and the authorities of the U.S. National Museum and also to Mr. E. B. Britton and the authorities of the British Museum (Natural History) and to Mr. J. C. M. Gardner, formerly of Dehra Dun. Much of the material described in the following pages was collected by the late F. Nevermann in Costa Rica and given to me.

It is possible that Rymer Roberts intended to restrict his keys to the genera described by him in detail, but it appeared more interesting to incorporate all the available evidence in this key, especially as the first larva of Helotinae has recently been obtained and described by A. Fukuda, who was kind enough to give me two specimens. This group has often been treated as a subfamily of Erotylidae, and its relationships are therefore shown in the key. The Diphyllinae—often considered a separate family Biphyllidae or Diphyllidae—appear to be intermediate between the first group of subfamilies of the Erotylidae and the Cryptophagidae and require comparison by means of the key. An additional reason for including the Diphyllinae was afforded by the fact that, through the courtesy of Dr. Thure Palm, I am able for the first time to compare both British genera of this group, so that the key contains all British genera of Erotylidae. It will be seen that in the larval stage the Diphyllinae can be classified almost as easily with the Cryptophagidae as with the Erotylidae. The Atomariinae with their bisegmented labial palpi cause a slight difficulty in separating the latter two families. Rymer Roberts (1939 : 91) was well aware of the differences existing between larval Atomariinae and Cryptophaginae but (p. 95) did not suggest how the definition of the family Cryptophagidae could be adapted to include the former. Therefore, the differences between the larvae of the families Cryptophagidae and Erotylidae are also summarised in the key.—*F. I. van Emden.*]

II. Dacninae Fowler

Westwood in his *Introduction* (1839) included *Dacne* with the Ostomidae in his large family Engidae, separating it from *Tritoma* and *Triplax*, which he placed in the Erotylidae. It was not until 1873 that Crotch separated certain

species as a new genus *Megalodacne*. Ganglbauer (1899) included *Dacne* in his subfamily Erotylinae, but Seidlitz (1887–91) placed it among the Cryptophagidae. In modern times it has become the custom to follow Crotch (1873) in uniting Dacninae with the Triplacinae and Erotylinae in the family Erotylidae, either including or excluding the Languriinae. It is significant that Verhoeff (1895) should have considered it necessary to separate the Dacninae from both Erotylinae and Languriinae on anatomical grounds, principally relating to the genitalia. But Sharp and Muir (1912), in their study of the male genitalia, found that the type of these organs in *Megalodacne* resembles that found in the other Erotylidae examined by them and that both approached that of the Cryptophagidae. This conclusion confirms that deduced from the respective larvae whereby the Dacninae occupy a position between the Languriinae and the Triplacinae (Roberts, 1939).

The subfamily comprises the genera *Dacne*, *Megalodacne*, *Episcapha*, *Thallis* and some smaller ones. Species of Dacninae are found in almost all parts of the world. Larvae are known of only the first three genera mentioned above; the first has been described several times, somewhat incompletely, those of the second and third by Candèze in 1861.

The principal characters of the adult are :—

Anterior coxal cavities closed, terminal segment of maxillary palp acuminate or abbreviated, not transverse; fourth tarsal segment scarcely reduced (e.g. *Dacne*), or short but quite visible; first 3 tarsal segments either cylindrical, or but slightly dilated and broadly fringed; inner lobe of maxilla without internal teeth; antenna with a terminal club of 3 segments.

The chief larval characters are :—

Head with epicranial suture obsolescent or with metopic branch present; ocelli 5–6, 4 in a square and 1 or 2 ventrally; mandible either with mola and with flat hyaline process between mola and apical teeth, or else without mola and with an inner fleshy process; apical teeth of mandible 3; articulating sclerite present; maxillary mala obtuse or at least not falciform, with row of setae along its inner margin dorsally; hypopharynx with or without anterior horns, following structure of mandible; tenth abdominal segment not arranged as a valve.

Reference has already been made (1939 : 89,90,96) to characters in which the larvae of *Dacne* and *Megalodacne* differ and which would seem to divide them, so that *Dacne* would be connected with the Languriinae or Cladoxeninae and *Megalodacne* with the Triplacinae. Such are: the highly-developed hypopharynx, the parallel epipharyngeal ridges, the crushing mola and flattened translucent retinaculum of the mandible in *Dacne*; the simple form of the hypopharyngeal bridge, the absence of ridges on the sides of the epipharynx and the membranous process in the hollowed inner margin of the mandible in *Megalodacne*. Reasons are given for the opinion of the author that this division of what he regards as a subfamily would be incorrect. There are moreover numerous characters in the larvae (apart from the adults) which the two genera have in common. Most of these are to be found in the list of the chief larval characters given above, but mention may be made of (1) the freedom of the labium, which extends as far as the base of the mentum, (2) the presence of a seta on the inner margin of the maxillary mala, a little posterior to the terminal unci and (3) the presence of a dorsal row of setae close to the inner margin of the

same. All these characters are common to the Dacninae, Languriinae and Cladoxeninae, but are not present in the Triplacinae or the Erotylinae.

On the other hand, attention has already been drawn (1939 : 90) to the broad, more or less obtuse, maxillary lobe of the Dacninae, with its tendency to division, found in the Triplacinae and Erotylinae. In addition, the number and pattern of the ocelli and the arrangement of the tenth abdominal segment connect this subfamily with the Triplacinae, though the further connections through the fleshy mandibular process, the absence of mola and the simple hypopharyngeal bar are made through *Megalodacne* and not through *Dacne*.

Dacne humeralis Fabricius

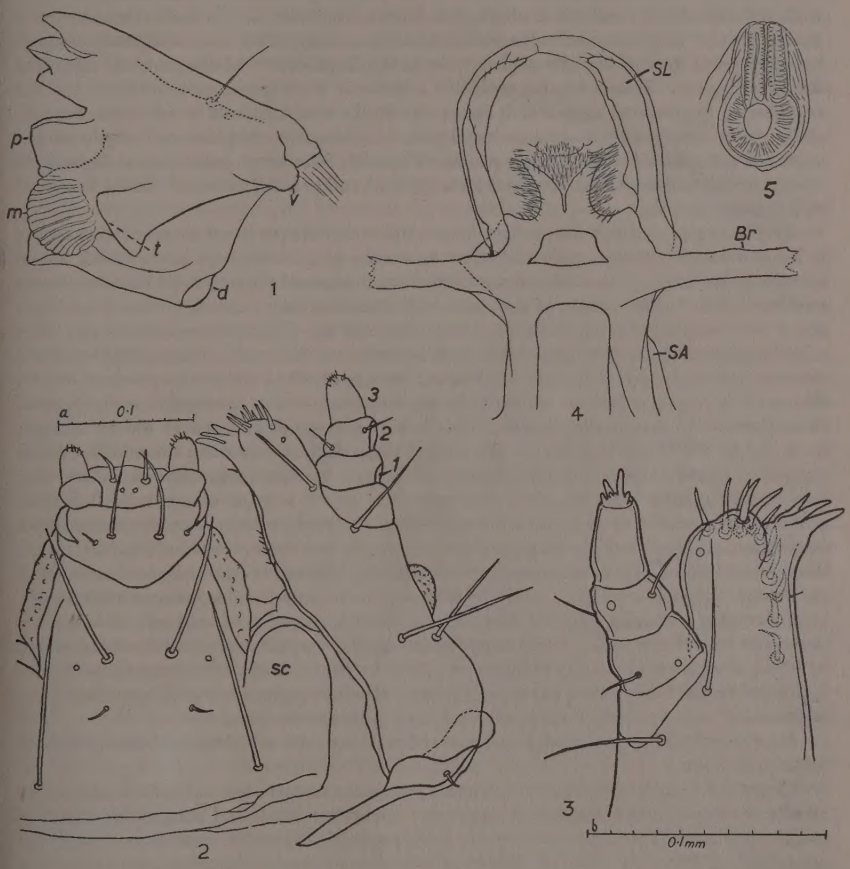
Larvae collected by Miss M. Vincent, who found them in *Polyporus* growing on elm at Cambridge, 1923 ; others given by Dr. F. van Emden, from Berlin-Hohenschönhausen, 11.vi.1935.

Length 4–5 mm., breadth of widest segments about 1 mm. Yellowish-white with a slightly thickened and darker bar or scutum on each segment, the longest being that of the pronotum ; broadly fusiform ; surface of body minutely shagreened and bearing a number of inconspicuous, short, pale setae ; a pair of pseudocerci present at the posterior end, upstanding and strongly bent forwards at the apex, rather widely separated from one another.

Head exserted, inclined a little downwards, so that the larva is hypognathous ; yellow, strongly rounded at the sides ; bearing on the vertex and frons short setae and a large number of small brown warts which form an elaborate symmetrical pattern on either side ; cranial sutures obsolete. *Clypeus* fused with epistoma and frons, but with epistomal ridge developed beneath the surface ; somewhat wider at anterior than posterior margin. *Labrum* articulating with clypeus ; rounded anteriorly, with the median portion paler in colour and slightly lobular and with some 12 setae along its anterior margin and 4 on each side dorsally ; anterior part of epipharynx corresponds with paler area of labrum just mentioned and is bounded on either side by an oblique corneous apodeme ; posterior to these, surface of epipharynx bears numerous oblique ridges. *Ocelli* 5–6 on each side, bearing black pigment ; placed in a cluster of 4, forming a square just posterior to the antennae, the fifth and largest ocellus more ventral and not far from base of mandible ; a sixth minute ocellus is also usually noticeable, posterior to fifth and in line with the two more posterior ocelli of the square. *Antenna* short, on a fleshy base ; the 3 segments subequal in length in approximate ratio of 21 : 24 : 24 ; a conical accessory segment present at end of second segment, ventral to third segment and of about two-thirds its length.

Mandible (Fig. 1) almost triangular in shape, carrying at apex 3 teeth, which function as a scoop ; on inner margin, ventrally, is an oval mola, marked transversely by distinct striae on inner ventral surface ; between mola and apical teeth is a large and thin translucent process, triangular in shape and having its anterior side slightly thickened ; base of mandible triangular in section, the outer and inner angles bearing muscle-attachments ; on ventral surface, near base of mola, a ridge is formed overlying the insertion of the adductor muscle. *Maxilla* (fig. 2) with the cardo incompletely differentiated at the surface ; beneath it, however, from outer angle of base to terminal point of hypostomal ridge, a substantial horny bar present having a short anterior branch, connecting maxilla with skeletal parts of head ; cardo articulates with stipes at an angle of more than 90°, the maxilla being thus kneed, as in most other members of the family. *Mala* (fig. 3) broad and rounded at anterior end, where a number of short, stout setae are situated, 3 of the largest [developed as rigid spines] being placed at the inner angle, pointing inwards and separated from the rest by a partial cleft in the ventral surface ; possibly this portion of the mala may represent the lacinia. On inner margin, posterior to these 3 setae, a very short, fine seta present, which

appears to correspond with the more robust one found in the Languriinae; dorsally, line of cleft marked by a row of 5 setae of curved shape, and this row is continued near anterior margin of mala; the three-jointed maxillary *palp* borne on a broad, nearly triangular palpiger. *Labium* (fig. 2) free as far as base of mentum; space between submentum and stipes, within angle formed by cardo and stipes, occupied by a weakly corneous articulating



FIGS. 1–5.—Larva of *Dacne humeralis* Fabricius: (1) left mandible, ventral view (L 2, 6, a); (2) labium and left maxilla, ventral view (L 2, 6, a); 1, 2, 3, segments of maxillary palp; (3) right maxillary mala, ventral view, setae of dorsal surface seen by transparence (L 4, 6, b); (4) hypopharynx (L 2, 6, a); (5) thoracic spiracle (L 4, 6, b).

sclerite, distinctly rounded anteriorly but ill-defined at sides and base. *Prementum* nearly straight on its anterior margin, between the biarticulate labial palps, and at base attached to mentum by a V-shaped articulation; *mentum* and *submentum* weakly developed, fused together and hardly distinguishable except by the transverse row of 4 long setae at base of mentum and the single pair near base of submentum; mentum narrower in front than

behind; posterior to submentum the space between the 2 posterior tentorial pits occupied by a transverse, membranous *gula*. *Hypopharynx* (fig. 4) well developed; the more horny skeletal parts forming a bar at base of mentum and attached on either side by a stout lateral ligament to base of corresponding mandible; posteriorly 2 suspensory apodemes extend backwards into head capsule, one on either side of oesophagus; medially the transverse bar is produced anteriorly in 2 curved and pointed processes or horns, each furnished with a brush-like investiture of short, fine hairs; ventrally and beneath prementum, a nearly circular membranous lingua is developed, connected at its base with horny parts of hypopharynx; to this are attached anteriorly the 2 processes which probably represent the superlinguae. *Ventral bay* for reception of inferior mouthparts quite distinct, but not very deep; hypostomal ridge which forms its margin bends inwards on each side beneath cardo, to terminate at posterior tentorial pits, on either side of tentorial bridge; at the angle the hypostomal ridge scarcely produced basally, forming no more than a slight knob or spur of thickened cuticle; occipital foramen moderately wide, but much less so than that of Triplacine larvae.

Pronotum almost semilunar, yellow, longer and rather deeper in colour than other terga; it bears a number of fine, pale and short setae, the longest of these being placed round margin of scutum. *Meso- and metanota* resemble abdominal terga, but lack the setiferous papillae; each dorsal scutum of abdomen with numerous pale setae of various length and also 2 setiferous papillae on either side of medio-dorsal line; in addition, each tergite bears a further pair of small setiferous papillae more laterally on either side; the papillae becoming more numerous towards posterior end of larva, the largest of the dorsal ones coloured brown. *Pleura* of thorax each divided vertically by a pleural suture into episternum and epimeron, the latter partly surrounding base of coxa behind; tergo-pleural suture almost straight from first to end of eighth segment, the margin being slightly excised in the middle of each segment; sterno-pleural suture somewhat excavate; in consequence the *sterna* are each narrower in middle than at anterior or posterior ends; a transverse row of fine setae present in the middle of each and a few short setae anteriorly; thoracic sterna fused into a single plate; abdominal pleura with a few extremely fine setae. *Ninth abdominal* tergite bears an additional pair of minute papillae medianly, between the other 2 pairs, and also a pair between the pseudocerci; apical part of each pseudocercus fuscous, pointed and strongly bent forwards; sternite situated ventrally, at anterior margin of segment, and bears a transverse row of fine setae. *Tenth segment*, which is extended postero-ventrally, enclosed by a fold of the ninth, probably the pleuron; tergum and sternum of tenth segment obscurely divided; anal tube bears a row of short setae around the apex, on which 2 papillate lobes are situated, side by side; anus lies immediately posterior to lobes.

Legs rather wide apart and somewhat short; claw curved inwards, bearing 2 short setae at its base.

Spiracles situated laterally, near anterior margin in mesothorax and a little anterior to middle in each of first 8 abdominal segments; somewhat small and annular-bicameral in shape; the 2 chambers directed dorsally in thoracic (fig. 5) and a little more posteriorly in abdominal spiracle; sides of chambers bear a large number of tooth-like thickenings along their lateral margins; a membrane covers greater part of roof of atrium, the opening being small; sides of atrium bear numerous hair-like trabeculae, which do not quite reach to middle of lumen; spiracular trachea short and bears a closing-apparatus, manipulated by a single lever, close to the surface.

Brief descriptions of the larva of *Dacne* have been given by Westwood (1839) and Bedel (1868). More recently Lamprecht (1924) has given a longer description. My observations do not entirely coincide with his, expecially in regard to the mandible and maxilla, and it has therefore seemed best to make a new description, which may serve for comparison with the descriptions given here of other members of the family.

Megalodacne fasciata Fabricius

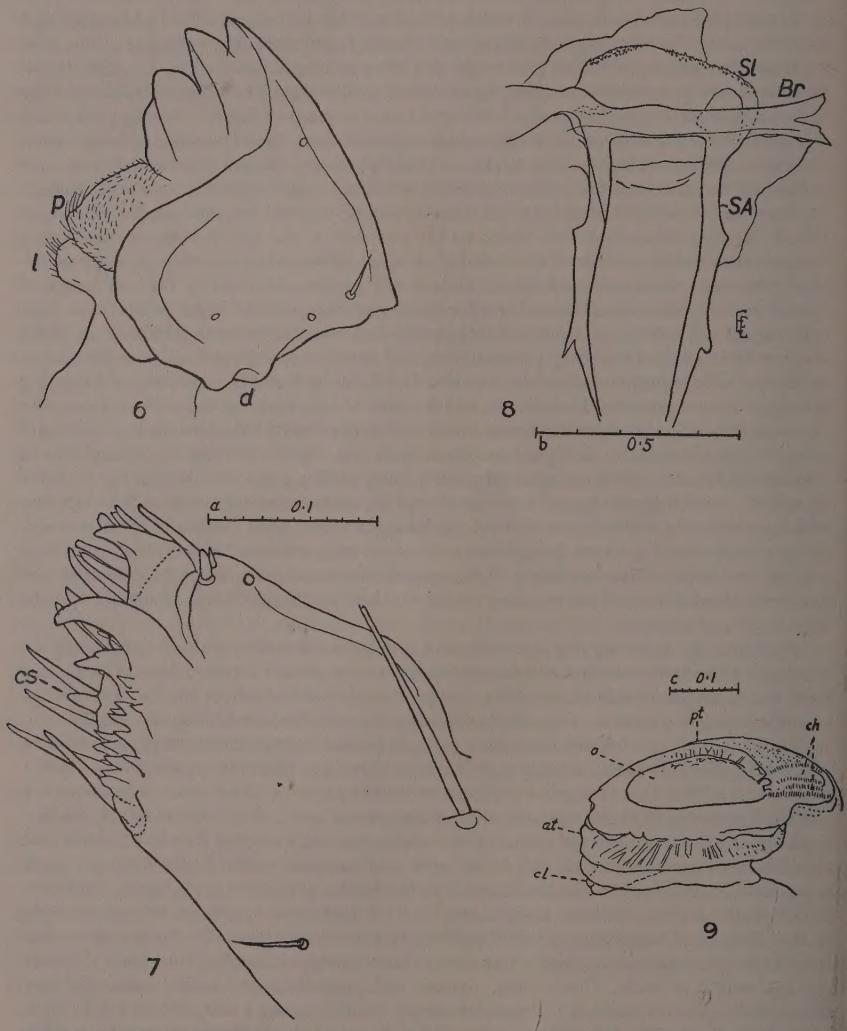
Three larvae collected by H. S. Barber from *Ganoderma* at Miller Lake, Wallisville, Texas, October, 1918.

Length of largest 14–15 mm., breadth of fourth abdominal segment (the widest) about 6 mm.; broadly fusiform, somewhat humped dorsally and flattened ventrally; the deep segmentation and cushion-like paratergal and pleural sclerites noticed by Candèze (1861) give the larva a somewhat swollen appearance; yellow, the head being infuscated with brown and each segment of body bearing a broad scutum of brown dorsally; all scuta rugose, those of eighth and ninth abdominal segments more than the rest; 2 short, stout, recurved pseudocerci borne at posterior extremity; many minute setae distributed over surface of body, arising from cuticular warts which are found especially on dorsal scuta.

Head a little broader than long and a little retracted within the prothorax at the base; yellow, strongly infuscated with brown on the two sides of the epicranium; upper surface bears a considerable number of short, simple setae; epicranial suture only partially developed, the short metopic branch being distinct and prolonged anteriorly for half length of frons; frontal branches visible only near base, anterior parts of frons being fused with epicranium and epistome; centre of frons somewhat raised between the furrows on either side; surface of head minutely granulated in and about these furrows and to a less extent on sides of epicranium but otherwise smooth. *Ocelli* 5 on either side, consisting of 4 forming almost a square, posterior to antenna, and 1 ventral to it, each having a strongly convex cuticular lens. *Clypeus* short and transverse, fused to frons at its base, though the epistomal ridge is visible beneath. *Labrum* transverse, with anterior border slightly emarginate in middle and bearing a large number of minute hairs at this point, in addition to the 10 or more stiff, incurving setae borne on either side of it; labrum articulated basally to clypeus, which exceeds it in width but is shorter. *Epipharynx* fleshy, both the horny apodemes and oblique striae found in *Dacne* being absent. *Antenna* very short and rather stout, placed on a large circular membranous base; first segment short and wide, second the longest and narrower, third short and narrow, only about one-half length of second, accessory segment very short and pointed.

Mandible (fig. 6) triangular in section and in superficial outline and not gouge-shaped; bearing 3 stout teeth at apex and a large membranous process between base of teeth and inner angle, attached to the inner side; this process clothed with short fine hairs, somewhat scantily arranged; at base of mandible adjoining the membranous process is a small round membranous lobe, also bearing fine hairs; no mola present, though inner margin is somewhat produced. *Maxilla* bent at a sharp angle between cardo and stipes, the space between it and labium being filled by a triangular corneous *articulating area* on either side; palp somewhat short but reaching to about same distance as the apex of mala. *Mala* (fig. 7) broad, pointed medially and bearing a curved uncus at the apex; ventrally bearing 2 further curved and claw-like unci on inner margin just below apex and an outer rounded lobe with two short setae and a rounded sensorium, comparable to the similar process found in many Triplacine and Erotyline larvae; on inner margin, not far from apex, a short conical seta comparable to that found in Languriinae and Cladoxeninae in a similar position. On the dorsal surface some 12 long and stout setae form a row close to inner margin, extending from apex to about one-half length of mala. *Cardo* long, narrow and pointed; *stipes* rather wide. *Labium* free almost to base of mentum; *prementum* nearly round, bearing a pair of stout biarticulate palps, with ligula rounded and scarcely produced; *mentum* somewhat rounded at sides and bearing pair of tapered setae in middle; *submentum* [separated from mentum by a complete, well-developed suture] wider, transverse, bearing pair of setae, one at each antero-lateral angle; *gula* a little shorter, transverse and of nearly same width as submentum, somewhat fleshy. *Hypopharynx* (fig. 8) consisting of a fleshy lingua on floor of mouth, a simple transverse bar connected by ligament with base of each mandible, and 2 long suspensory apodemes, one on either side of pharynx; surface of lingua minutely granulate, but no

trace of superlinguae. *Ventral bay* both wide and long, nearly rectangular, but wider at base than anteriorly and considerably wider than long, reaching nearly to occipital foramen; posterior tentorial arms oblique and prominent, one on either side of concave tentorial bridge; hypostomal ridge not extending beyond posterior angle of ventral bay.



FIGS. 6–9.—Larva of *Megalodacne fasciata* Fabricius: (6) right mandible, dorsal surface (L 4, 3, c); (7) left maxillary mala, ventral view (L 2, 6, a); (8) hypopharynx (W 1, 3, b); (9) thoracic spiracle (L 4, 3, c).

Pronotum considerably longer than tergum of any other segment, enclosing base of head; brown tergal plate extends laterally further than those of other segments; interrupted by a fine pale suture medially; in other segments, up to eighth abdominal, suture is

dagger-shaped and wider on prescutum, with a narrower continuation behind ; tergum of each rugose, especially those of eighth and ninth abdominal segments ; rugosity is derived from the numerous small cuticular warts of various sizes with which the surface is sprinkled. No regular rows of setae, but numerous very short setae borne on the cuticular warts. *Pleural suture*, between terga and pleura, distinct and deep, the sternal suture less so, but sufficient to separate clearly pleura and sterna ; thoracic pleura each divided into episternum and epimeron by a transverse suture. Anterior part of paratergite in mesothorax contains the large thoracic spiracle. Abdominal sterna almost devoid of cuticular warts but bear numerous minute hairs or setae comparable with those borne on warts on the dorsal surface ; each divided by oblique sutures on either side into eusternum and laterosterna. Dorsal surface of *ninth abdominal segment* brown and covered with cuticular warts of various sizes, bearing short setae ; a little behind anterior margin is present a transverse row of 6 corneous protuberances, larger than the other warts ; the 2 short *pseudocerci* rather widely separated at end of segment and with a number of setiferous warts at the base ; apex corneous, smooth and somewhat recurved. Tergum of ninth segment surrounds the greater part of tenth, but in this region is more fleshy and nearly devoid of warts, though bearing numerous short hairs ; sternum forms a curved bar, separating tenth segment from eighth. *Tenth segment* placed near middle of ventral surface of ninth ; tubular and terminated by 2 ambulatory lobes, side by side ; though retractile, it lacks the valvular structure found in the Languriinae.

Legs short, placed wide apart, progressively wider from first to third pair ; coxa stout and, compared with other segments, long, coming to a blunt point on inner side ; tarsus short and terminated by a short curved claw.

Thoracic spiracle (fig. 9) placed close to anterior margin of mesothorax, in the anterior of the 2 divisions of paratergite ; oval like the other spiracles, widely-open and bears 2 accessory chambers directed dorsally ; cuticle corrugated at either side of each chamber ; atrium widely open to surface and bears a number of short spicule-like trabeculae on sides ; outlet to trachea guarded by comb-like series of straight teeth, projecting from sides to middle of lumen ; at base of atrium, and consequently near surface of cuticle, is a single well-developed lever for closing the aperture to the tracheal system ; abdominal spiracles also placed near anterior margin of each of segments 1–8 in lateral part of tergite.

Böving and Craighead (1931) give figures of this species, and its general aspect has been described by Candèze (1861), who draws attention to its deep segmentation and prominent sclerites on the ventral and lateral surfaces.

III. Triplacinae (= Tritominae Arrow)

This subfamily comprises that portion of the family, included by Crotch (1873) as Triplacides, following, as he supposed, the classification of Lacordaire, and by Ganglbauer as his tribe Triplacini. It excludes the Dacninae for reasons already explained (1939 : 90–91) and also the Erotylinae (sen. str.). The Encaustini, separated from Triplacini and Erotylini as a distinct tribe by Handlirsch (1925) and Kuhnt (1909), have been included as a division of his subfamily Tritominae by Arrow (1925). The genera composing it are chiefly East Indian, though one extends also to Africa and Southern Europe. They are distinguished primarily by the two sharp teeth at the apex of the inner lobe of the maxilla in the adult, these being absent from the Triplacinae. Unfortunately the larvae are not known, and therefore I am not in a position to discuss their relationship [but see key, p. 282].

Arrow (1925 : 121) points to the large number of intermediate forms between *Tritoma* and *Triplax* in the adult stage and also to Perris' reference (p. 527)

to the close similarity of the larvae. He concludes, therefore, that they must all be included within a single genus. [Rymer Roberts' draft here mentions Arrow's conclusions as to the validity of the names *Tritoma* and *Triplax*, Tritominae and Triplacinae. In the most recent works the two genera are again separated, and according to the Copenhagen alterations of the rules of nomenclature the name of a supragenеric group is not to be altered because of the synonymy (as opposed to homonymy) of the type genus. Therefore it seems advisable in the present paper to adhere to the nomenclature used in Roberts' 1939 paper.]

Amblyopus triplacoides Gorh.

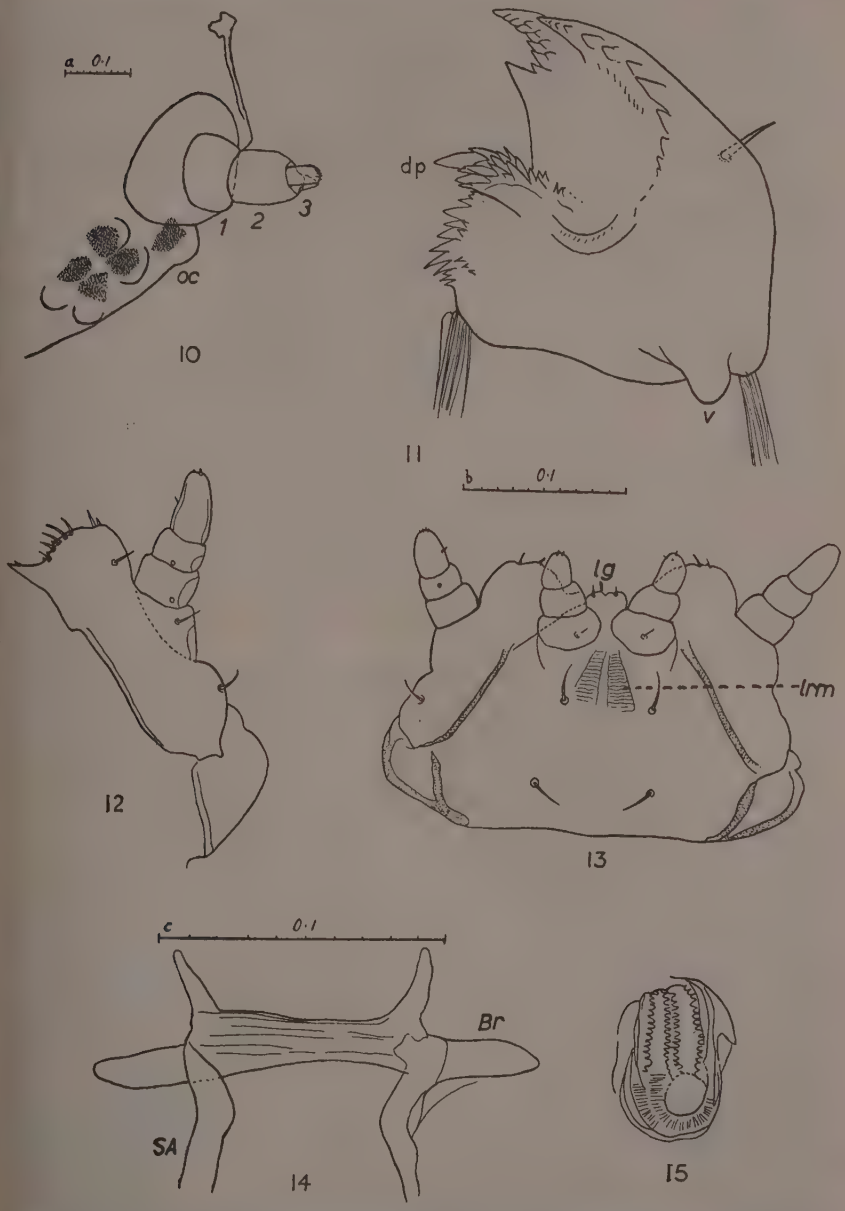
A number of larvae were taken by Mr. J. C. M. Gardner in fungus at Dehra Dun, United Provinces, India, on 9.viii.1934. Of these about 40 were preserved and the remainder kept for breeding; 57 adults of this species and four of *A. cinctipennis* Lac. emerged. The presumption is, therefore, that the larvae examined belong to *A. triplacoides*. Parts of final exuviae of *A. cinctipennis* (labium, maxilla, spiracle) examined were, however, found to be almost identical with the corresponding parts of *A. triplacoides*, so that the larvae of these two species are evidently very similar. Candèze (1861) has given a short description of *A. cinctipennis*.

Length about 10 mm., breadth of third abdominal segment about 2·25 mm.; arched above, less so beneath, somewhat thickened in the middle and tapering in front and behind; white, with head, dorsal and pleural plates brown; spiracles margined with brown; pseudocerci somewhat short, pointed and slightly upturned; cuticle minutely granular dorsally and ventrally.

Head slightly retracted above, much broader than long, rounded at the sides, a little inclined but hardly hypognathous; two shallow longitudinal fossae present in frontal area; cranial sutures obsolescent, but with traces of a lyre-shaped epicranial suture extending to posterior margin; setae slightly capitate and very short. *Ocelli* 5 (fig. 10), with a small additional spot of pigment ventrally in most specimens; 4 of the ocelli in the form of a square, posterior to the antenna, the other 2 placed more ventrally; pigment black. *Clypeus* fused with frons, short, transverse, bearing a row of 6 setae on dorsal surface. *Labrum* articulated to clypeus, rounded anteriorly and bearing about 10 short, pointed setae along margin and also a pair on dorsal surface. *Epipharynx* with a transverse group of minute spines medially near the anterior margin and 3 round sensoria on either side posterior to it. *Antenna* (fig. 10) short, placed on a wide circular basal process; first segment broader than long, second nearly cylindrical, longer and narrower than the first, third only about one-half length of first; accessory segment conical, jointed and raised on a process, so that it reaches almost to end of third segment.

Mandible (fig. 11) with 3 pointed teeth at apex, the most dorsal of these being subsidiary to the larger middle tooth; both larger teeth with somewhat long serrations along their inner margins; mandibular process, which arises in the hollow between dorsal and ventral surfaces, bears a considerable number of spines, as does inner margin of pseudo-mola[2]; at distal end of mandibular process one of the spines is developed into a prominent digitate projection directed inwards and somewhat dorsally; this projection is also present in larva

[2] [I cannot find an explanation of this term in Rymer Roberts' manuscript and notes. It is obvious that the term is not used in the same way as by Böving and Craighead, where it is applied to an asperate process on the *dorsal* part of the mandibular base, but that it refers to the interior basal part when it is not asperate. Therefore in *Dacne*, the Cladoxeninae, etc., a mola (or better molar) is present in the place in which in Triplacinae and Erotylinae only a pseudo-mola in Rymer Roberts' terminology is developed.—F. v. E.]



FIGS. 10–15.—Larva of *Amblyopus triplacoides* Gorh.: (10) right antenna and ocelli (L 4, 3, a); 1, 2, 3, segments of antenna; (11) left mandible, ventral view (L 2, 6, b); (12) left maxilla, ventral view (L 4, 3, a); (13) ventral mouthparts, ventral view (L 4, 3, a); (14) hypopharynx (L 4, 6, c); (15) second abdominal spiracles (L 2, 6, b).

of *A. cinctipennis*. *Maxillary mala* (fig. 12) rounded on anterior margin and bearing at inner angle a process which partially covers entrance to mouth and which terminates in a pointed uncus and also carries a short pointed seta near the apex on its dorsal surface; anterior margin of mala bears 5 rather stout setae, in addition to 3 short horny processes or unci; outer portion shows little sign of division from the rest but bears, as in other genera of the subfamily, a round sensorium and 2 short setae near anterior margin. Nearer the base, on ventral surface, are 2 short setae, one near the outer, the other near the inner margin. Inner margin of *stipes* nearly straight, outer margin contracted in the middle and showing the interior process protruding from beneath; all setae short. Division between cardo and stipes nearly straight; inner margin of *cardo* almost in a straight line with that of stipes, but in a different plane, the cardo being infolded at base of maxilla; thickened outer and inner margins unite before the apex and are continued to a point which articulates with the hypostomal ridge, a little beyond the line of the inner margin of cardo and stipes. No [sclerotisation on the] articulating area present between maxilla and labium. *Prementum* (fig. 13) broader than long, rounded and sometimes with a margin of darker cuticle at the base, which may be extended between the palpigers. *Ligula* protruding between the palps, united at the base but cleft deeply in the middle into 2 anterior lobes, which are again cleft less deeply into 2 on either side; outer lobes of either side each bear a short tapered seta pointing anteriorly. *Postmentum* membranous and scarcely divided, but a slight fold sometimes visible, which, from the position of the mento-submental muscles, appears to indicate the division between mentum and submentum; each division bears a pair of major setae; *gula* short and transverse, a little wider than submentum. *Hypopharynx* (fig. 14) without submedian horns, but with a pair of somewhat short slender processes supporting the membranous lingua, attached to the hypopharyngeal bridge; lingua somewhat hairy at anterior end and bearing beneath the prementum a pair of lappets clothed with longer hairs, the superlinguae. *Ventral bay* more than twice as broad as long, rounded on either side posteriorly.

Pronotum bears 3 transverse rows of minute capitate setae, each placed eccentrically on a papilla; other tergites, up to the eighth abdominal, bear only 2 such rows. Each scutum brown, interrupted medially by a narrow white suture of thinner cuticle. Spiracles placed on anterior of the 2 pleural sclerites in the mesothorax and in the pale paratergal area on either side of first 8 abdominal segments; pleural sclerites lacking on prothorax and fused with tergite and sternite in ninth abdominal segment. Sterna pale and transverse, bearing only a few extremely short, fine setae. *Ninth abdominal segment* yellowish-brown above, bearing a few short pointed setiferous papillae, similar to those of other segments, but not arranged in definite transverse rows; 2 pseudocerci borne at posterior margin of segment, separated from one another by a wide semicircular space; slightly upturned, pointed and provided on surface of each with 4 or 5 setiferous papillae, similar to, but smaller than, those of the tergite; sternum slightly pigmented and bearing 2 transverse rows of very short setae. *Tenth abdominal segment* posteroventral, circular at base and surrounded by the ninth; anal pseudopod tubular and bearing a pair of ambulatory lobes, side by side at apex, around which a few minute setae are borne.

Legs rather short and placed wide apart; coxa long in proportion to other segments and nearly conical; femur and the slender tibia rather short; claw long, curved inwards and sharply pointed.

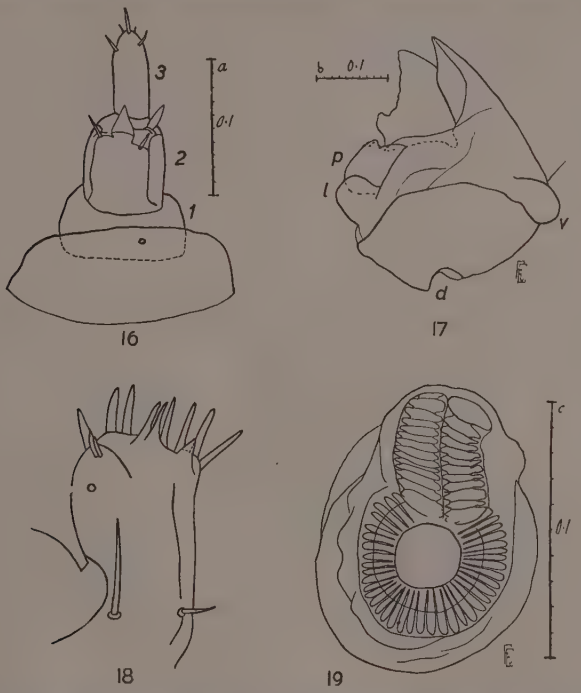
Spiracles (fig. 15) annular-bicameral, with peritreme of each raised a little above surrounding cuticle; those on mesothorax placed on anterior of the 2 pleural sclerites on either side, the abdominal in anterior half of pale paratergal area of each of first 8 segments; structure of all similar, the abdominal being but slightly smaller than the thoracic spiracle; the 2 chambers of moderate length and curved convexly; each bordered on either side by short teeth and bearing a series of transverse furrows at the bottom; atrium rather shallow, its walls bearing rather short bluntly-pointed trabeculae; aperture round, contracted by membrane which is strengthened by slightly stouter ribs. Entrance to trachea protected

by long pointed trabeculae, concentrically arranged and curved inwards. Spiracular trachea wide and rather short, with a single occlusor lever at its internal end.

Triplax russica L.

Two larvae taken on 18.viii.36 in *Polyporus* on ash by Herr Karl Dorn at Kösen, Ost-Thüringen, were kindly given to me by Dr. F. van Emden.

Length about 7 mm., breadth (of second abdominal segment) about 2 mm.; somewhat arched, scarcely fusiform but a little narrowed in front and behind; sutures rather deep



FIGS. 16–19.—Larva of *Triplax russica* L.: (16) antenna, ventral view (L 2, 6, a); (17) left mandible, ventral view (W 4, 3, b); (18) right maxillary mala, ventral view (L 2, 6, a); (19) thoracic spiracle (W 4, 6, c).

dorsally and ventrally; creamy-white, dorsal surface of head and scutum of each segment thickly sprinkled with brown warts, mostly minute; setae short and rather numerous, those on dorsal surface slightly thickened at the end, those on the ventral gradually tapered; pseudocerci upturned, recurved at apex.

Head inclined, slightly retracted into prothorax, almost semicircular, bearing many small brown cuticular warts dorsally, arranged in a symmetrical pattern. A shallow fossa present on either side of frons; frons cordate, its shape being defined at the sides by translucent lines running through the fossae and continued posteriorly to a point, near hinder margin of head; the short clear space posterior to frontal lines may represent the metopic suture; all setae gradually tapered and moderately long. *Ocelli* 5 on either side, arranged in a group

of 4, almost forming a square, and 1 ventral to it ; each ocellus covered by a corneal layer raised above the surface. *Clypeus* short and transverse ; fused to frons, but with epistomal ridge showing at base (when cleared) ; bearing 4 tapered and somewhat wavy setae on dorsal surface. *Labrum* articulated to clypeus, short, rounded, bearing 2 longer and 2 shorter setae dorsally ; anterior margin with a row of 4 or 5 short, incurved setae on either side and a pair of still shorter ones in the middle, the latter followed by 2 rows of minute sharp spinulae behind them ; no sensillae visible on epipharynx. *Antennae* (fig. 16) short ; first segment broader than long, second longer than first but considerably narrower, third slightly longer than second ; accessory segment at end of second segment, ventrally, short and pointed, surrounded by 3 or 4 short setae ; base wide and nearly circular.

Mandible (fig. 17) wide, bearing 3 apical teeth, of which the innermost is shorter and subsidiary to the intermediate tooth ; outer margin flattened, bearing 2 short setae ; rounded mandibular process between dorsal and ventral surfaces bears 4 or 5 rows of spinous scales at its anterior end and a few minute cuticular hairs nearer the base ; proximal to it, on left mandible, is a small membranous lobe projecting inwards ; median and longest tooth slightly serrated along its inner margin and ventral tooth bears a slight flange. *Maxilla* somewhat narrow. *Stipes* a little contracted in middle and rounded at base, where it almost conceals the cardo ; outer part of *cardo*, which projects beneath stipes, rounded, the inner part consisting of little more than a slightly bent marginal rod, to which the inner bundle of muscles is attached ; anterior parts not differentiated from stipes and adjoining fleshy area ; articulating sclerite absent. *Mala* (fig. 18) truncate, bearing on its anterior margin 3 cuticular spines or unci ; 2 of these placed near together submedially and setiform, the third, at inner angle, triangular and sharply pointed ; also at the inner angle is a stout socketted spine, directed anteriorly ; dorsally and near anterior margin is a row of 5 stout setae projecting anteriorly ; ventrally a subconical lamina is nearly separated from rest of mala ; it bears a longer and 2 shorter setae at apex and a round sensorium a little posterior to them ; at base of mala a short seta is borne near inner margin and a long one near palpifer. *Labium* free to a point only a little beyond articulation of prementum and mentum. *Ligula* distinct, rounded and bearing 2 incurved setae ventrally. Basal margin of *prementum* straight ; the prementum bearing a pair of somewhat long setae, its sides somewhat narrowed to the base. *Mentum* and *submentum* membranous, separated only by a slight fold ; each with a pair of rather long setae. *Hypopharynx* simple, the transverse bar nearly straight and extending on either side by ligamentous material to base of mandible ; no suspensory apodemes present, but a corneous, round knob on either side of transverse bar, resting on either side of pharynx ; anteriorly the membranous *lingua* extends from transverse bar beneath prementum ; its anterior end with a rather indefinite lobe, scantily covered with short hairs, on either side. *Ventral bay*, for reception of inferior mouthparts, much broader than long and broader posteriorly than anteriorly, the posterior angles being rounded.

Body, dorsal scuta brown, each, up to eighth abdominal segment, interrupted medially by a pale suture ; surface finely granulate, bearing minute brown warts ; setae fine and short, varying in length and slightly capitate. *Prothorax*, the longest segment bearing 3 transverse rows of setae ; *meso-* and *meta-thoracic* and first 8 *abdominal scuta* each with 2 rows ; the setae borne on sides of brown horny papillae, which are larger towards posterior end of body ; pleuro-tergal suture rather obscure. *Pleura* consisting of 2 swollen areas on either side of each of first 8 abdominal segments, the anterior bearing numerous short, scarcely capitate, setae ; pleuro-sternal suture distinct. *Sterna* widest in middle, each bearing a row of longer setae posteriorly and numerous short setae anteriorly ; ventral setae not capitate. *Ninth abdominal segment* with a row of 8 larger setiferous tubercles amongst the smaller brown warts near anterior margin of tergum ; other smaller tubercles scattered over surface to basal parts of pseudocerci and posterior end of segment ; these tubercles with capitate setae, which arise near base, but not in middle, of each ; the 2 *pseudocerci* placed wide apart, the aperture between them V-shaped ; their apices smooth,

pointed and much recurved; pleura forming an arch which surrounds sternum and tenth abdominal segment; ninth sternite with a transverse row of longer setae and a few shorter setae at either side. *Tenth segment* forms base of anal tube and bears a few short setae; anal tube placed postero-ventrally and terminating in 2 fleshy lobes, side by side.

[*Legs* pale yellowish, moderately stout, separated by width of a coxa or, the posterior ones, a little more widely; setae rather short; coxa as long as trochanter and femur together, subcoxa divided normally into an anterior and posterior part, tibiotarsus conical-truncate, about as long as femur, claw fully half as long as tibiotarsus, moderately curved, basal part pale yellowish, more than apical half rusty red.

Mesothoracic *spiracle* (fig. 19) situated on a triangular callosity between lateral parts of pro- and mesonotum, its air chambers moderately long and pointing dorsal. Abdominal spiracles, which are similar, placed somewhat in front of middle of dorsolateral part of first 8 abdominal segments, the chambers pointing dorsal and slightly raised above general surface; opening of atrium circular and rather large; the 2 chambers, which are open and about as long as diameter of peritreme, strengthened by transverse ridges and protected on either side by a row of short spines; atrium contains rather long unbranched closely placed trabeculae, which project into the lumen; entrance to trachea with even denser simple trabeculae, which radiate to the centre; *closing apparatus* lies on a somewhat lower level and is formed by a single lever.]

Tritoma pulchrum Say.

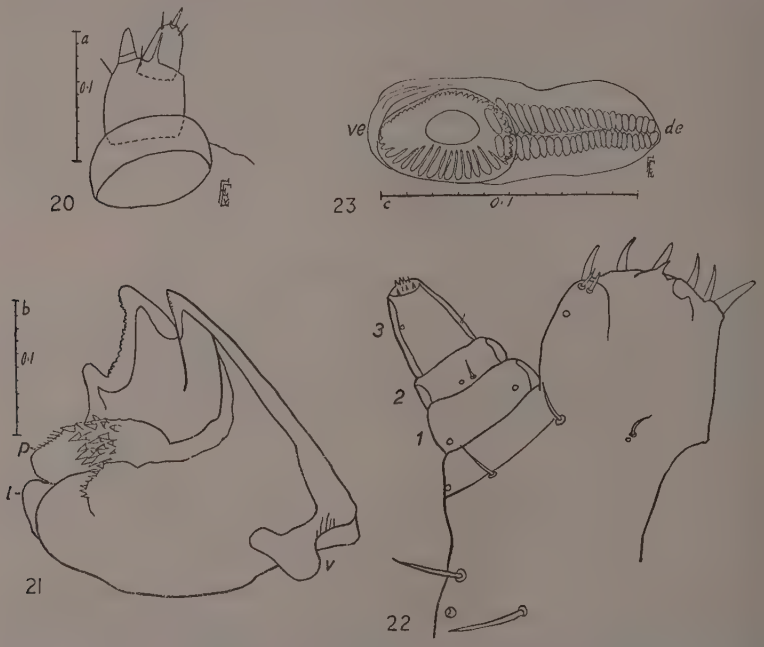
Two larvae were taken from fungus on decayed river birch, together with two pupae and two adults. Larvae taken on 4.x.1919 and retained alive, pupated in earthen cells on 17.x.1919; and adults had emerged by 27.x.1919. The specimens were collected by R. St. George at Falls Church, Va., and received through Dr. A. G. Böving from the U.S. National Museum, Washington, D.C.

Length 6–7 mm., breadth of thorax rather more than 1 mm.; pale yellow, head a little darker; scarcely fusiform in shape, but tapered a little in front and behind; dorsal scuta granular, bearing short capitate or club-shaped setae; sterna bearing rather longer, simple setae; pseudocerci little darker than body, only slightly recurved.

Head exserted, broader than long, only slightly inclined downwards, yellow; epicranial suture obsolescent, frontal branches alone being distinct, metopic branch absent; surface minutely granulate and bears a few rather short tapered setae. *Ocelli* 5 on either side, arranged in a group of 4 in a square, posterior to antenna and one ventral to it. *Clypeus* short and transverse, fused to frons, but with epistomal ridge developed between them, bearing 4 setae dorsally. *Labrum* articulated to clypeus, short, rounded at sides, bearing 4 short setae dorsally, with 4 rather short setae on either side of anterior margin and a pair of shorter ones medially; in the middle, anterior margin also bears 3 rows of minute sharp spinulae, turned inwardly. *Epipharynx* in the middle [just behind these spinules] with a cluster of about 8 minute sensillae, but with the remainder smooth. *Antenna* (fig. 20) short, placed on a circular fleshy base, within which it can be partially retracted; first segment broader than long, second a little longer than first and noticeably broad dorsoventrally, third nearly as long as second and placed dorsally; accessory segment about half length of third segment, pointed and placed at ventral extremity of second.

Mandible (fig. 21) very similar to that of *T. unicolor*, figured by Böving and Craighead (1931); almost gouge-shaped and bears 3 teeth at or near apex, 2 being subequal in length and curved inwards, the third much shorter, placed on inner margin of dorsal surface; base of mandible broad and with a few minute cuticular spines, but no mola developed; in hollow between dorsal and ventral margins is a rounded fleshy process, bearing spinous scales on its anterior border in some 5 irregular rows; at its base the left mandible bears a small membranous lobe (*l*), adjoining the fleshy process. *Maxilla* (fig. 22) short and somewhat

broad ; palp exceeds length of mala and projects antero-laterally. *Cardo* mostly concealed beneath base of stipes, the division between them nearly straight and horizontal ; the thickened inner margin almost in a straight line with that of stipes, but when it reaches the base the cardo is continued in a long slender arm, almost to posterior tentorial pit. *Mala* broad and obtuse ; at inner angle a stout, socketted, conical spine, projecting inwards ; on anterior margin 3 short, thorn-like, cuticular processes or unci between middle and inner margin ; ventrally, at outer margin, an almost conical lamina is nearly separated from the rest and bears a longer and 2 shorter setae at apex and a rounded sensorium a little posterior to them ; close to anterior margin of mala, on dorsal surface, a row of 5 long tapered setae present ;



FIGS. 20–23.—Larva of *Tritomâ pulchrum* Say: (20) left antenna, ventral view (W 2, 6, a) ; (21) left mandible, ventral view (L 2, 6, b) ; (22) right maxilla, ventral view (L 2, 6, b) ; 1, 2, 3, segments of maxillary palp ; (23) thoracic spiracle (W 4, 6, c).

inner margin bare of setae but 2 are placed ventrally near the base, 1 close to palpifer, the other near outer margin ; articulating sclerite absent. *Prementum* short and transverse, separated from mentum by a suture ; palpigers wide and reaching to the base. *Ligula* projecting between palps as a rounded process, bearing 2 straight setae. *Mentum* and *submentum* almost membranous, separated by a slight suture ; each carrying a pair of somewhat long, tapering setae. *Hypopharynx* with transverse bar reduced to a narrow band of strong corneous tissue, connected by a ligament with base of mandible on either side ; membranous lingua connected at its base with the bar and extending forwards beneath prementum ; a small patch of short cuticular hairs on either side of anterior margin appears to represent the superlingua, as in *T. praevia*. In *T. unicolor* these are longer. though no lobe is developed; postero-dorsally a long suspensory apodeme attached to median bar on either side, running on either side of pharynx almost to dorsal surface of head. *Ventral bay* more than twice as broad as long, with hypostomal ridge bounding it on either side rounded at base ; the

latter not prolonged towards base of head beyond base of maxilla ; tentorial bridge wide, as is occipital foramen, the latter extending almost to posterior angles of head.

Pronotum bears 3 rows of short, slightly clubbed setae, the other segments from mesonotum to eighth abdominal tergum 2 rows ; pleura with 2 still shorter setae, sterna a single row of longer tapered setae on each. Tergum of *ninth abdominal segment* somewhat granulate on surface, with a row of short slightly clubbed setae above and 4 or 5 longer setae laterally ; a few longer clubbed setae placed at base of pseudocercus posteriorly ; pseudocerci short, pointed and scarcely recurved ; ninth sternum situated anterior to anal tube and bearing a single row of setae. *Tenth abdominal segment* forms base of anal tube and is protruded ventroposteriorly ; at its apex it bears 2 round fleshy lobes, side by side, the anus being posterior to them ; a row of setae surrounds the apex.

Legs yellowish, of moderate length, placed somewhat wide apart and each bearing a few short setae ; the coxa the longest segment and placed on a subcoxa divided longitudinally into two by a brownish suture ; claw is rather long and curved.

Mesothoracic *spiracle* (fig. 23) placed anteriorly and laterally, its long, pointed chambers pointing dorsally ; abdominal spiracles similar, placed near middle of segments to which they belong, the chambers pointing postero-dorsally ; all spiracles annular-bicameral, but chambers of those in abdomen distinctly raised above general surface of cuticle to a greater degree than those of thorax, aperture to atrium circular and widely open ; and 2 long, narrow chambers, strengthened by transverse ridges and protected on either side by a row of short spines, also open ; atrium bears short unbranched trabeculae, placed rather wide apart, projecting into lumen ; and entrance to trachea guarded by closely-set trabeculae which radiate to the centre. *Closing apparatus* placed a little below surface at end of short spiracular trachea ; it is formed by a single lever, which operates the bow close to the constricted valve, when the muscle attached to it contracts.

Though the spiracles of all the known species of *Tritoma* are of the annular-bicameral type, there is considerable variation in detail. The writer has examined those of three species, and Dr. A. G. Böving has been kind enough to send him sketches of those of a further three species, together with several of *Triplax*. *T. flavipes* Lac. (*angulatum* Say) agrees with *T. pulchrum* Say in having the chambers (together with the peritreme surrounding them) long and pointed, *T. sanguinipenne* Say with *T. unicolor* Say in having them of moderate length and not pointed, and finally the European *T. bipustulatum* F. agrees with the Indian *T. praevium* Gorh. in having the chambers short and wide, in proportion to their length. Among those species which have been referred to *Triplax* all those examined (*T. russica* L., *T. thoracica* Say), together with *T. aenea* Schall. and *T. flavicollis* Lac. examined by Dr. Böving, have short or moderately short chambers.

IV. Erotylinae Ganglbauer

As already explained (1939 : 92) this name is retained to signify the subfamily regarded by Ganglbauer as the tribe Erotylini. It had been called *Erotylides* by Crotch in 1873, following the French termination given to subfamilies by Lacordaire. But the name does not, of course, connote the subfamily Erotylinae of Ganglbauer, which includes Triplacinae and Dacninae, besides Erotylinae as now proposed. The group Encaustini, included by Ganglbauer in his tribe Erotylini through *Aulacochilus*, [appears to have the main characters of the Erotylinae, *see* p. 280]. If the Encaustini are excluded, the members of the subfamily are confined to the New World, most of them being found in tropical or subtropical America. The larvae live and presumably feed upon fungus but,

as was pointed out by Candèze (1861), in the case of *Aegithus quadrinotatus*, usually on the surface, as is to be expected from the development of long dorsal spines in so many of the larvae known.

The characters of the adult Erotylinae may be summarised as follows :

Anterior coxal cavities closed ; terminal segment of maxillary palp securiform or triangular, transverse ; third tarsal segment bilobed, fourth hidden within the third ; inner lobe of maxilla with 2 horny hooks or teeth ; antennae with or without club.

The chief larval characters are :

Epicranial sutures obsolescent or obsolete ; antennae placed somewhat far back on head, posterior to anterior angles ; second antennal segment elongate, usually 3 times or more as long as third ; clypeus usually articulated to frons, but sometimes fused to it ; epipharynx without parallel ridges ; ocelli 5–6 on either side, arranged much as in Triplacinae ; articulating areas fleshy ; mandible without mola, with fleshy process interiorly, with 3 apical teeth ; maxillary lobe obtuse, with outer lobe partially divided, lacking a row of setae dorsally along inner margin ; hypopharynx without anterior horns or developed superlinguae ; spiracles annular ; terminal pseudocerci sometimes developed as long filaments.

Superficially the larvae of this subfamily appear to differ considerably from those of the Triplacinae. The frequent possession of long spines on the body, of long filamentous pseudocerci and of comparatively long antennae are obvious distinguishing characters. However, the form of the mandible with its fleshy process, the simple form of the hypopharynx and the obtuse form of the maxillary mala, with its tendency to division, are among the characters common to both subfamilies which indicate their close relationship. The occipital foramen is not so wide, in proportion to the width of the head, as in the Triplacinae ; but in *Cypherotylus* it is somewhat wide, comparable to that of the Languriinae. In *Aegithus*, *Coccimorphus* and probably in *Homoeotelus* it is narrowed, to an even greater extent than in the Dacninae.

It has already been pointed out (1939 : 91) that all other subfamilies of Erotylidae which have been investigated show the annular-bicameral condition of the larval spiracles, but that in the spiracles of *Cypherotylus goryi* there are processes which can only be interpreted as undeveloped chambers.

The condition found in *C. goryi*, however, is not present in all larvae of Erotylinae, nor even in all larvae of the same genus. Though no sign of chambers is visible in the spiracles of *C. boisduvali*, they show a slightly recurved lip outwardly on the dorsal margin, and, at least in the thoracic spiracles, a similar development of the trabeculae into T-shaped processes in the same region as in the abdominal spiracles of *C. goryi*. Such trabeculae are also found in the same position in the spiracles of *Aegithus meridionalis*, though no recurved lip is present. In *Coccimorphus dichrous* and *Homoeotelus gemellatus* no lip and no extra development of the normal short hairs on the surface of the atrium has been found.

It seems, therefore, that in the larval Erotylinae, though none of the spiracles is annular-bicameral, several stages in the disappearance of this condition are to be found : (1) the presence of a lip, with partial development of the chambers, as found in *Cypherotylus goryi* ; (2) the presence of a lip, with development of substantial trabeculae in the same region, as in *C. boisduvali;* (3) the develop-

ment of similar trabeculae only, in the region where the lip and chambers might be expected to develop, as in *Aegithus meridionalis*; (4) the simple annular spiracle, as found in *Homoeotelus gemellatus* and *Coccimorphus dichrous*.

Coccimorphus dichrous Lacordaire

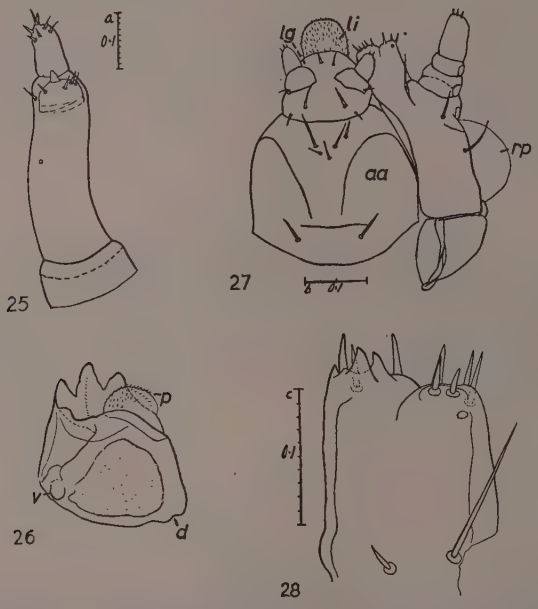
Two larvae, collected by Herr F. Nevermann on [the bark of] *Coumarouna panamensis*, 25.v.34 [Hamburg Farm, Reventazon, Costa Rica] were kindly lent by Dr. F. van Emden.

Length in spirit about 10 mm., breadth of metathorax 3 mm. Fusiform, rounded above and beneath, gradually tapered behind (fig. 24). General ground-colour creamy-white; tergal plates yellow, suffused with fuscous around bases of spines, which are black; a broad white medio-dorsal stripe extends from mesothorax to seventh abdominal segment; pseudocerci stout, horny, and upstanding; pleural spines situated beneath spiracles on each of first 8 abdominal segments; ventral surface creamy-white and fleshy, sutures deep; legs rather long, fuscous.

Fig. 24.—Larva of *Coccimorphus dichrous* Lacordaire × 10.

Head hypognathous, yellow, with a broad brown infuscated band extending dorsally from near base to antenna and ocelli on either side; slightly wider than long, rounded at sides; cranial sutures obsolete; surface minutely granulated; a transverse row of 4 stout setiferous spines present on vertex near base and a further pair submedianly a little anterior to them, each spine bearing a fine, socketted, tapered seta at its apex and unbranched; in addition dorsal surface also bears a large number of short tapered setae, mostly situated on central fascia and bordering the 2 longitudinal fossae, which border the epicranial plates, one on either side; occipital foramen distinctly contracted. *Labrum* transverse, rounded at sides, nearly straight on anterior margin, the latter with 6 or 7 short setae, projecting ventrally on either side. *Clypeus* short, narrowed anteriorly, articulated with frons and when cleared showing epistomal ridge beneath surface; a little narrowed in front and bearing 3 setae dorsally on either side. *Epipharynx* papillose. *Ocelli* 5–6 on each side; 4 placed within the brown band mentioned above forming almost a square immediately behind antenna; the other placed somewhat ventrally to them and, in addition, a further small pigmented spot may also occur; the 5 principal ocelli raised above the surface, each on a brown papilla having a clear round apex. *Antennae* (fig. 25) rather short, placed somewhat far back on head, on stout raised bases, brown; segments in approximate proportion of 10 : 55 : 15; accessory segment placed ventrally at end of second segment and consisting of a minute conical process which is situated on a rounded knob, bearing also 3 short setae.

Mandible (fig. 26) scoop-like, with 3 teeth at apex, the middle one being the longest; beneath dorsal margin a rounded semimembranous process extends anteriorly and inwardly and is somewhat sparsely clothed with minute short hairs. *Maxilla* (fig. 27) appearing broad on account of extension outwards of a rounded process which arises beneath stipes. *Cardo* somewhat short, curving inwards to point which articulates with skeleton of head beneath fold of labium; distal margin transverse and nearly straight; whole cardo forming an obtuse angle with longitudinal axis of stipes, basal articulation being nearly in line with inner margin. *Mala* (fig. 28) obtuse, bearing 2 tooth-like unci and 2 shorter projections ventrally on anterior margin, close to inner angle; a rounded lobe ventrally projects slightly at outer angle and bears a small round sensorium and anteriorly 5 spinous setae;



FIGS. 25–28.—Larva of *Coccimorphus dichrous* Lacordaire: (25) antenna (L 4, 3, a); (26) right mandible, basal view (L 4, 3, a); (27) ventral mouthparts, ventral view (L 2, 3, b); (28) mala of left maxilla, ventral view (L 2, 6, c).

arising on its anterior or dorsal surface inner lobe also bears 3 setae directed forwards; inner margin of mala without setae. *Labium* (fig. 27) with obtusely-rounded ligula projecting a little beyond base of palps and bearing 2 short submedian setae; prementum distinctly separated from mentum by a transverse suture; mentum and submentum almost membranous; the division between them rather obscure, but its position confirmed by insertion of mento-submental muscles just anterior to suture; mentum bears a pair of submedian setae of moderate length, in addition to several short setae irregularly disposed; submentum white and swollen and also bearing a pair of setae of moderate length; on either side of mentum a swollen fleshy articulating area occurs which is semi-oval anteriorly; its division from rest of mentum may be traced almost to mento-submental suture. *Gula* membranous and inflated, narrowed to margin of submentum, where it lies between the posterior tentorial pits. *Hypopharynx* consists chiefly of a simple, transverse, horny bar, connected by a ligamentous process with base of mandible on either side, and 2 slender

suspensory apodemes which extend inwards from hypopharyngeal bar, one on either side of pharynx; lingua, attached at its base to hypopharyngeal bar, extends in a fleshy process beneath prementum and in front of it, to form a tongue at entrance to buccal cavity; clothed with numerous fine, short hairs. *Ventral bay* rounded at posterior angles and wider posteriorly than anteriorly; no extension of hypostomal ridge towards base of head beyond posterior angles.

Pronotum (fig. 24) yellow, with fuscous band surrounding scutum on all sides and forming a narrow band beyond it; the black marginal spines not branched, but a number of minor spines arise among the larger ones on anterior and lateral margins of plate; 7 principal spines present on each side along anterior and lateral margins, each spine bearing a tapered and socketted seta at its apex; a pair of slightly recurved spines also occur submedially, on posterior margin of plate; between these 2 spines a narrow, pale median suture arises and is continued as a broad median stripe from mesonotum to eighth abdominal tergite, where it is again narrowed. On *mesonotum* and on each tergite thereafter to eighth abdominal segment, are 3 branched spines on either side of median suture; each branch bearing a short fine seta at its apex; submedian and intermediate spines each bear 2 branches, lateral 5 or 6 in abdominal segments and even more in thoracic segments. *Pleura*, pale in colour and with a black spine on each of abdominal segments 1 to 8; this is multibranched but has a single apical point; thoracic pleura without spines, except for a small brown callosity on each mesopleuron, just ventral to spiracle; callosity bears a longer seta arising from a papilla and several shorter setae. Sternopleural suture somewhat obscure and diagonal, constricting sternum of each segment anteriorly. *Sterna* pale, separated from one another by deep sutures and bare of all major setae; rather numerous fine and short minor setae may, however, be seen with the microscope, forming a transverse band across middle of each abdominal segment. *Ninth abdominal tergum* (fig. 24) has the number of spines reduced, pseudocerci, which are stout and black, apparently each representing 2 of spines of anterior segments, which are submedian and bear a spine projecting posteriorly from base of each; each trifurcate at apex and with a number of short branches arranged spirally round it; laterally tergum bears a pair of spines on each side, unbranched, save for a small accessory spine at base of each; pleura and sternum united with tergum and together form a ring round *tenth segment* which is placed ventro-posteriorly, beneath pseudocerci; tenth tergite, posterior to anal pseudopod, bears a few microscopic setae and is united with tenth sternite, which also bears a few similar setae, surrounding the fleshy pseudopod; this bears 2 lobes, side by side, anus lying between them and tenth tergite.

Legs placed wide apart, yellowish-brown; bearing a number of fine, short setae; coxa the longest segment and rather broad, tapering gradually from base to apex; femur rather short; tibia about two-thirds length of coxa; claw rather long, hooked and bearing 2 setae of unequal length at base.

Spiracles annular and widely open, the rim of each raised a little above surface of body; they are placed in paratergites of mesothorax and of each of first 8 abdominal segments, dorsal to pleural spines; atrium of each spiracle bears numerous minute hairs, arranged in rows on its surface; spiracular trachea protrudes into base of atrium, its entrance being guarded by numerous hairs concentrically arranged; it is rather long, at least in mesothorax, and closing-apparatus, if present, must be at a considerable distance from spiracle; several short setae placed close to spiracle posteriorly, in addition to those situated on pleural callosity more ventrally.

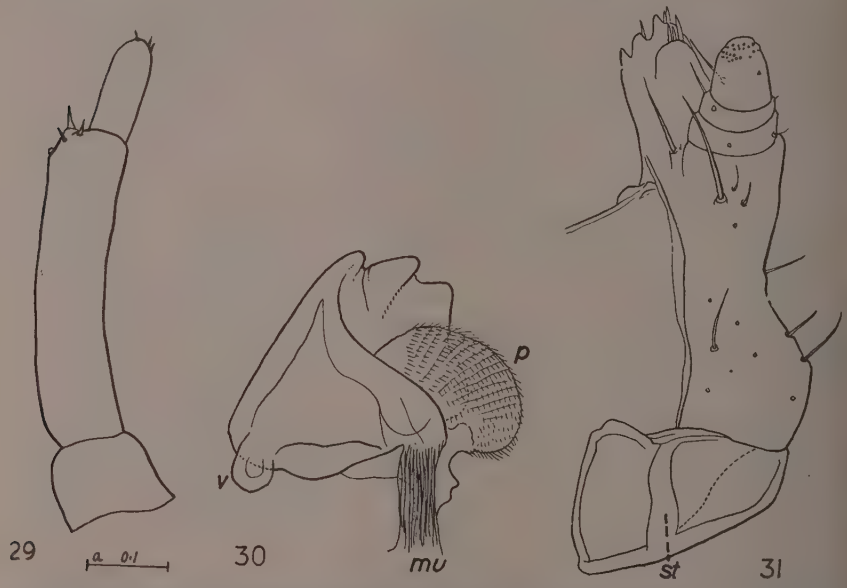
Aegithus meridionalis Crotch

Two larvae were kindly lent by Dr. F. van Emden. They were collected by Herr F. Nevermann at Guapiles, Costa Rica on 22.iv.1935, from a fungus growing on a dead log. The largest specimen taken by him pupated on 3.v.1935.

Length of larger larva about 10·5 mm., breadth of thorax about 2·5 mm., after preservation in alcohol. Elongate-oval; body a little tapered behind, less so in front; arched above,

flattened beneath. Head ventral. Body brown, bearing on dorsal surface a large number of stout racemose spines ; 2 short terminal spines represent the pseudocerci.

Head ventral, yellow, sunk in prothorax as far as base of prementum and ocelli ; on vertex 2 dark fossae converge posteriorly nearly to occiput ; dorsal surface shagreened with minute setiferous warts, but becoming smooth towards posterior margin ; it also bears slender spines, almost cylindrical, with a short pointed seta at apex of each, and many tapering setae of varying length, borne on raised papillae ; occipital foramen nearly circular and distinctly contracted, much as in *Coccimorphus*. *Labrum* semicircular, bearing on its anterior margin a large number of fine, inwardly-directed setae, the 3 or 4 outermost of which, on each side, longer and stouter than the rest ; dorsal surface bears a row of 4 setae



Figs. 29-31.—Larva of *Aegithus meridionalis* Crotch : (29) antenna (L 4, 3, a) ; (30) right mandible, ventral view (L 4, 3, a) ; (31) left maxilla, ventral view (L 4, 3, a).

near anterior margin. *Clypeus* transverse, narrowed in front, with a transverse row of 4 setae at base ; fused to epistome and frons, but epistomal ridge well developed and rises above surface of clypeus. *Epipharynx* minutely granular. *Ocelli* 5 on each side, raised on tubercles above general surface ; of these, 4 almost form a square in an infuscated brownish area, posterior to antenna, the remaining ocellus being placed ventral to the rest. *Antennae* (fig. 29) on raised bases, rather short, placed considerably behind anterior margin of head, on a level with tentorial bridge ; first segment short, about one-quarter length of second, third segment a little more than one-third length of second ; accessory segment at apex of second, sharply pointed and socketted near its base, one-third length of third.

Mandible (fig. 30) gouge-shaped, with 3 bluntly-pointed teeth at apex ; a large fleshy process attached to dorsal surface on its inner margin, clothed with minute hairs on both surfaces. *Maxillary mala* (fig. 31) obtuse, bearing on its anterior margin 3 short bluntly-pointed unci ; and also 4 or 5 setae of varying length on or near margin ; on ventral surface, near outer angle, a rounded lobe projects slightly from the surface and bears 2 short setae close together at distal end ; no sensorium has been found upon the lobe. *Palp* short and

consisting of 3 segments on a short palpifer ; a rather long tapered seta arises on a raised papilla on base of mala, close to palp. *Stipes* rather narrow, without any process arising beneath surface. *Cardo* subtriangular, broad on ventral surface and extending inwards beyond inner margin of stipes, supported submedially by a broad corneous band ; posterior margin curved and reflected internally. *Labium* V-shaped and fleshy, but with prementum and anterior part of postmentum a little more corneous. *Articulating areas* cushiony, nearly triangular, the labium being narrowed to a point at its base between them ; labium free only to base of *prementum* which is short, composed almost entirely of divided palpigers and underlying ligula. *Ligula* slightly produced, rounded, bearing 2 tapered setae, each placed on a small papilla ; postmentum not divided. *Hypopharynx :* a horny transverse bar extends across middle of ventral bay, supported on either side by a ligament which connects it to hypostomal ridge and base of mandible ; from it a fleshy diaphragm, supported by 2 suspensory apodemes, extends inwards to pharynx, almost at right angles to ventral surface of head ; dorsal to transverse bar and projecting beyond it anteriorly, is a rectangular plate, connected by narrow stays to bent suspensory apodemes ; this structure is at base of and assists in support of membranous lingua, which lies beneath terminal part of labium. *Ventral bay* wider than long, nearly rectangular, but having the angles slightly rounded ; it reaches to within a short distance of occipital foramen.

Pronotum with a row of 4 stout, racemose spines on either side of anterior margin, 1 pair submedianly behind them, and, posteriorly, a row of 3 on either side. (There are thus 16 spines on the pronotum, whereas Candèze gives only 14 for the larva of *Aeg. quadrinotatus*.) Each tergite from *mesonotum* to eighth *abdominal* tergite with 3 racemose spines, within a darker plate, on either side of medio-dorsal line. The longest branches, arising from their apices, each bowed and tapered gradually to a point ; but lateral branches straight and bear at tip a long, easily-detachable seta ; both kinds of branch bear a large number of minute barbules along their surfaces and it is possible that in life they have an irritating effect on would-be predators. Prothoracic *pleura* without spines, but those of meso- and metathorax each bear 2 small spines ; each abdominal pleuron of first 8 segments bears only 1 racemose spine, gradually decreasing in size towards posterior end of larva ; pleurosternal sutures somewhat oblique. *Sterna* without spines, but with very short, fine setae in a transverse row across each ; sterna somewhat narrower in front than behind and become progressively more and more curved at sides to ninth abdominal sternum, which is nearly crescentic. *Ninth abdominal segment* without spines, save for the 2 short terminal ones, representing pseudocerci ; these shorter than tergal spines on other parts of body, but, like them, have branches though only short ones ; tergum also bears a small tuft of short setae on either side ; ventrally ninth encloses the tenth segment within a circular space, the tergum and sternum of the ninth being obscurely separated by a slight suture on either side. *Tenth segment*, when pseudopod is retracted, as in specimens examined, seems to be composed of a posterior or tergal part, consisting of 2 curved elongate processes, connected by membrane, and the anterior, invaginated, sternal part, which is partly surrounded by tergal processes and has the appearance of 2 lobes connected at the base.

Legs placed widely apart and protruding beyond sides of body ; of moderate length, and bearing a few fine short setae ; coxa a little shorter than femur, thickened in middle and terminating in a distinct knob on inner side ; trochanter oblique, rather short ; tibia slightly tapered to apex, and of about same length as femur ; claw rather long and curved, bearing 2 short setae at its base.

All *spiracles* annular, widely open and having the rim raised a little above general surface; interior of atrium bears slight concentric ridges, on which are placed numerous minute hairs ; close to surface and near most of dorsal margin these hairs are replaced by longer and T-shaped trabeculae, as in abdominal spiracles of *Cypherotylus goryi*, to be described later. Entrance to trachea guarded by a circle of closely-set, incurved hairs ; spiracular trachea moderately long and terminated by a closing-apparatus, worked apparently by a single lever. Thoracic spiracles situated in anterior portion of each mesothoracic pleuron, close to

margin and just dorsal to small anterior pleural spine ; each contained within a shallow pit, open dorsally. The 8 pairs of abdominal spiracles situated laterally in paratergite, between dorsal and pleural spines on either side ; slightly smaller but otherwise similar to thoracic spiracles.

Cypherotylus goryi Guérin-Méneville

Two larvae collected by Herr F. Nevermann in Costa Rica, one of them from fungus growing on a dead tree at Hamburg Farm, 27.v.1934, the other without definite data, were received for examination through the kindness of Dr. F. van Emden.

Fig. 32.—Larva of *Cypherotylus goryi* Guérin-Méneville × 5.

Length (in spirit) about 21 mm., breadth of mesothorax about 7·5 mm. Broadly eruciform and slightly tapered to head and terminal segments (fig. 32). Dorsal surface dark brown, nearly black, with 2 orange-yellow spots, one on either side of median suture, on each segment, except prothorax and ninth abdominal segment where they are confluent ; from the prothorax to third abdominal segment median suture is white ; 2 brown, tail-like pseudocerci arise from posterior end of ninth abdominal segment ; each about 11 mm. in length and tapering gradually to apex ; ventral surface and pleura of larva yellow.

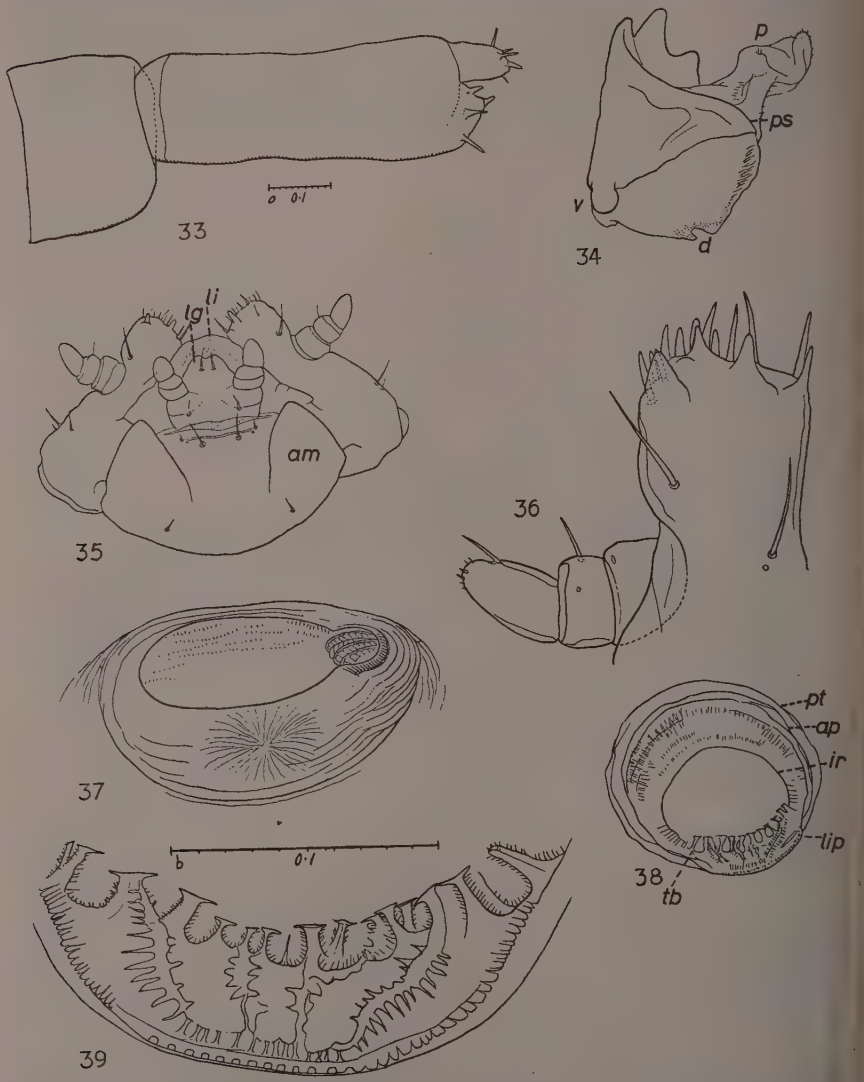
Head considerably narrower than prothorax and retracted a little within it ; yellow, with a fuscous patch on dorsal surface extending in a narrow band from antenna to undefined margin of frons on either side. Occipital foramen large and circular, but not quite reaching to sides of head ; surface almost bare of major setae, but bearing, mainly on vertex and frons, numerous small brown papillae, from each of which a minute seta arises ; metopic suture obsolescent, frontal sutures entirely obsolete, their position being occupied by 2 deep fossae, one on either side. *Ocelli* 6 on either side, raised above general surface, consisting of 4 in a square behind antenna and 2 more ventral. *Clypeus* short and transverse, almost

membranous anteriorly, where it is articulated with labrum, but having a distinct suture at base, where it is fused to the frons. *Labrum* rounded at sides, slightly produced anteriorly and bearing a tuft of 5 or 6 inwardly-directed setae at anterolateral margin on each side. *Epipharynx* smooth and fleshy. *Antennae* (fig. 33) placed at some distance from anterior margin of head, somewhat short, mainly fuscous, each standing on a circular membrane, which is outlined with a brown rim; first segment short and wide, covered at distal end with minute granulations; second segment narrower than first and nearly $2\frac{1}{2}$ times as long [more than 5 times as long and $2\frac{1}{2}$ times as wide as third]; third segment narrow, scarcely reaching beyond papilla of accessory segment; ventrally apex of segment is produced in a rounded process bearing several short setae and terminating in a short conical papilla representing the accessory segment.

Mandible (fig. 34) scoop-like, bearing 3 rounded teeth at apex; no mola, but inner margin considerably produced; dorsally, between base and apical teeth, a long tongue-like process, clothed with minute hairs distally [and on dorsal surface] is attached to dorsal surface and produced inwardly; in section base of mandible nearly triangular. *Maxilla* (fig. 35) long and inclined inwards; triarticulate *palp* short, hardly exceeding length of mala and projecting laterally. Under part of *stipes* scarcely projects beyond outer margin. *Mala* (fig. 36) obtuse, nearly square, bearing 4 horny processes or unci on its anterior margin, ventrally, in addition to the setae; near outer margin is a lobe on the ventral surface, the lobe being terminated anteriorly by one of the unci; it also bears a small sensory pit, and has 2 short setae standing between it and main part of mala; dorsally mala has an oblique row of some 6 setae near anterior margin, in addition to 7 placed on anterior margin; inner margin bare of setae. *Cardo* scarcely visible from ventral surface; nearly almond-shaped, apex extending inwards to articulation with cranium, base lying beneath stipes; axis forms an angle with that of stipes of less than a right angle. *Labium* (fig. 35) free only as far as base of prementum; articulation between pre- and postmentum clearly shown by a transverse brown bar; former bears a pair of biarticulate palps, between which is a ligula having 2 blunt points at the extremity and a pair of moderately long setae near it. Mentum and submentum fused together and bear 2 pairs of setae, a longer and a shorter pair, in a transverse line at anterior margin; on either side, between maxilla and labium, is a large triangular fleshy lobe, representing the articulating area, which does not quite reach to base of labium posteriorly but extends at its apex a little beyond articulation of prementum. Near base of labium is a pair of short setae, placed widely apart, representing submental setae. *Hypopharynx* consists mainly of a narrow horny bar, connected at either side by a ligament with base of mandible; anterior margin of bar straight, but postero-dorsally a long suspensory apodeme supports hypopharynx on either side of pharynx; ventrally a membranous lingua occupies dorsal side of prementum; this is clothed with minute hairs. *Ventral bay* for reception of inferior mouthparts nearly rectangular, somewhat short and more than twice as broad as long; hypostomal ridge not prolonged towards base of head at its posterior angle; postoccipital ridge and tentorial bridge both strongly corneous, though somewhat narrow.

Body (fig. 32): dorsal surface of each segment bare, save for minute brown setiferous papillae, thinly scattered over surface, as on that of head. Scuta of thorax form more distinct plates than those of abdominal segments: on each segment from mesothoracic to eighth abdominal are 6 brown bosses, raised in a transverse row, at posterior margin of scutum. Each abdominal *pleuron* bears a long, pointed, spiniferous process of dark brown colour; 2 similar but smaller processes on each thoracic pleura, those on prothorax being more reduced than the others. *Sterna* transverse and bare of all major setae; separated from one another by deep sutures. *Ninth abdominal* tergum yellow and bare of spines, but with a large number of minute setiferous tubercles along lateral and posterior margins; the tubercles being continued spirally round the 2 long pseudocerci to their apices; function of pseudocerci unknown; they are brown and placed close together with a rounded, but not excavated, space between them; ninth sternite a narrow bar anterior and contiguous to

tenth segment. *Tenth abdominal* segment pale in colour and placed postero-ventrally immediately beneath pseudocerci; anteriorly it is partially surrounded by sternum of ninth segment and for remainder of its circumference by tergum of same; anteriorly,



FIGS. 33–39.—Larva of *Cypherotylus goryi* Guérin-Méneville: (33) right antenna, ventral view (L 4, 3, a); (34) right mandible, ventral view (L 4, 1b; scale not available); (35) ventral mouthparts, ventral view (L 2, 1b; scale not available); (36) mala of right maxilla, ventral view (L 4, 3, a); (37) thoracic spiracle (L 4, 3, a); (38) spiracle of first abdominal segment (L 4, 3, a); (39) lip of first abdominal spiracle more strongly enlarged (L 4, 6, b).

in specimens examined, there is a crescentic slit, through which anal pseudopod is probably evaginated; 2 small lobes, almost triangular in shape, placed posterior to this slit, the 2 lobes together probably representing tenth tergite; each has a dark fascia in the middle.

Legs fuscous at base and yellow clouded with brown thereafter; short and stout, widely separated, each bearing a rather long, curved claw at its apex; coxa nearly half length of leg, bluntly pointed at apex; trochanter and femur together shorter than coxa; femur and tibia both short, 2 partially developed brown spines situated at base of each coxa laterally, both developed into short, pointed spines in prothorax alone; in meso- and metathorax the more anterior of each pair remains a mere knob.

Thoracic *spiracles* placed near anterior margin of mesonotum, and dorsal to anterior pleural spine on either side; a rudimentary spiracle, in form of a brown spot, situated in a similar position on each side of metanotum. Mesothoracic spiracle (fig. 37) oval, widely open, but with rim a little turned inwards; peritreme dark brown; at bottom of atrium aperture to trachea closely guarded by trabeculae which radiate to centre; at dorsoposterior end spiracle shows distinct vestiges of 2 chambers, but these chambers little developed and appear to have no respiratory function; they consist of 4 lamellae set on edge and enclosed within a horse-shoe-shaped projection which extends outwards a little beyond margin of rim; walls of atrium bear numerous minute hairy trabeculae, which become much larger and pointed in neighbourhood of chambers. Abdominal spiracles (fig. 38) nearly circular, but on dorsal edge have a slightly reflected lip; rest of margin bears a membranous inner rim projecting a little over lumen; on walls of atrium are numerous short fine hairs. On surface of lip are 4 slight ridges (fig. 39), the 2 median ones only being parallel to one another; the other 2 diverge outwardly in their course towards the lumen; each ridge bears numerous trabeculae projecting on either side; on surface of atrium contiguous to lip are a number of T-shaped trabeculae, which bear fine hairs along their sides; these are only present beneath reflexion of lip.

It is suggested in the introduction (1939 : 91) that, had such a spiracle been further developed, the 2 median ridges would have fused together to form a central septum, leaving 2 outer chambers to form part of the system of an annular bicameral spiracle and so conforming to the general type found in other subfamilies of Erotylidae.

Cypherotylus [*aspersus* Gorh.=] *boisduvali* [Crotch nec] Chev.

Through the kindness of Dr. A. G. Böving and the authorities of the U.S. National Museum I have had the opportunity of examining two larvae of this species from Las Vegas, New Mexico, taken on 2.viii.1901. These specimens are considerably smaller than the larvae of *C. goryi*, being only about 11 mm. in length. Both have similar long caudal appendages and a rather pointed ligula, but *C. boisduvali* is seen at a glance to differ from *C. goryi*, apart from size, in the development of the dorsal spines on the body. In *C. goryi* these are represented by rudimentary bosses, in contrast to the definite spines developed around the tergal plate in the prothorax and across the subsequent segments (up to the eighth abdominal segment) in *C. boisduvali*. The characters of the head and mouthparts are generally similar in the two species, but the membranous process of the mandible is longer and narrower in *C. goryi* than in *C. boisduvali*. [See also the figures in Böving and Craighead, 1931, pl. 41.] The spiracles of *C. boisduvali* are annular and show no sign of the rudimentary chambers found in *C. goryi*. Each of them has, however, a slightly recurved lip on the dorsal margin, and in the thoracic spiracle the normal short hairs, borne on the lining of the atrium, are replaced by T-shaped trabeculae in the region of the lip, such as are found in a similar position in *C. goryi*.

Homoeotelus gemellatus Lacordaire

Two larvae collected by Herr F. Nevermann from leaf of [the palm *Asterogyne* sp.], 31.i.1935, at Limon, Hamburg Farm, Costa Rica, No. 638, were received through the kindness of Dr. F. van Emden; the larger was near the pupal ecdysis.

Length of larger larva 9–10 mm., breadth at metathorax (the broadest segment) 3 mm. Broadly fusiform; yellow, with 3 longitudinal rows of dark spines usually branched and generally arising from brown infuscated areas on either side of tergum (fig. 40); the brown areas confluent on either side in abdomen, but separated in thorax except in the case of each of the areas at base of the 2 pairs of median spines, which are united; a somewhat wide pale line runs medio-dorsally between the rows of spines from mesothorax to posterior end. Legs and antennae long, giving larva an onisciform appearance. Pseudocerci upturned, rigid, hardly longer than spines, brown.

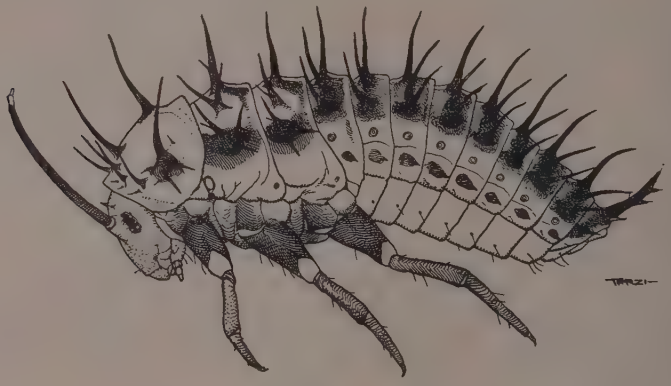
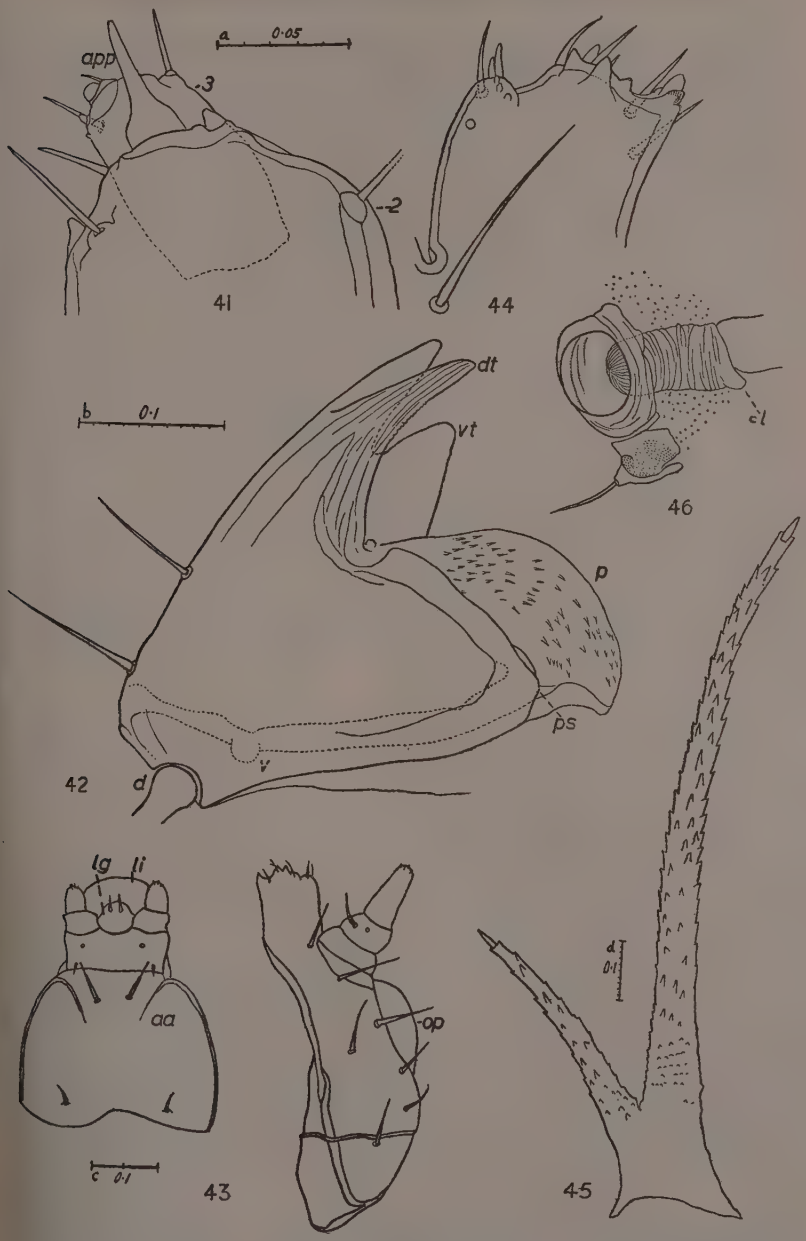


Fig. 40.—Larva of *Homoeotelus gemellatus* Lacordaire.

Head yellow, rounded at sides, almost equal in length and breadth, hypognathous, somewhat retracted within prothorax and invisible from above; no epicranial suture. A number of very short and fine setae, scarcely visible, borne on cranium and a row of 4 short setiferous spines on vertex; occipital foramen appears to be somewhat contracted. *Labrum* transverse, rounded in front and at sides, bearing 4 short setae dorsally on either side and ventrally a large number of fine, slightly curved, setae directed backwards along anterior margin. *Clypeus* short, transverse, fused to frons; narrower in front than behind and a little emarginate anteriorly. *Ocelli* situated in a brown patch, a little behind base of each antenna; each brown patch bears 4 circular clear spaces, raised, in form of a square, above general surface dorsally and 2 further clear spaces, side by side, ventrally; these clear spaces are the corneae of the 6 ocelli, themselves darkly-pigmented. *Antennae* placed far back on head, a little anterior to middle, long; first segment short and ring-like, but second about 2 mm. in length and comprises most of length of antenna; third segment (fig. 41) at apex of second, dorsally, appears as a short rounded process; accessory segment represented by a minute pointed papilla placed on somewhat swollen apex of second segment ventrally; base of antenna somewhat raised above surface of head and directed backwards; third segment infuscated with brown, deepest in middle, its apex, like other segments, brown-coloured.

Mandible (fig. 42) with 3 apical teeth of which 2 are nearly equal in length and more



FIGS. 41–46.—Larva of *Homoeotelus gemellatus* Lacordaire: (41) apex of antenna, ventral view (L 4, 6, a); 2, 3, second and third antennal segments; (42) left mandible, dorsal view (L 2, 6, b); (43) ventral mouthparts, ventral view (L 2, 3, c); (44) mala of right maxilla, ventral view (L 2, 6, b); (45) branched tergal spine (L 4, 3, d); (46) thoracic spiracle (L 4, 3, d).

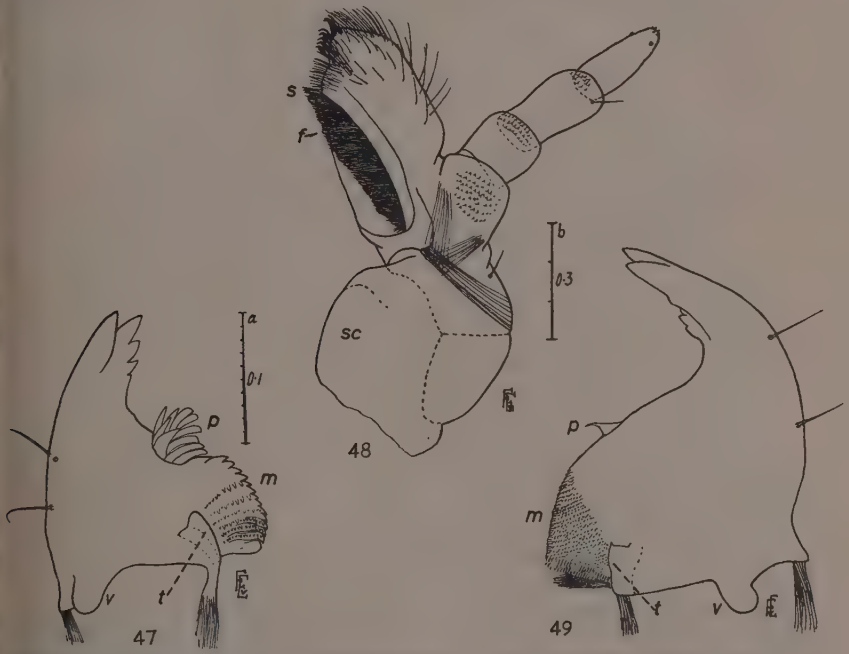
pointed, the third (most ventral one) somewhat shorter and blunter; dorsally, between base of mandible and base of most dorsal of apical teeth, a thin semimembranous process extends inwards; on both surfaces somewhat sparsely clothed with many fine short hairs. *Maxilla* (fig. 43) appearing rather broad, on account of projection of outer process, which arises beneath surface of stipes and extends beyond its margin. Cardo broad, subtriangular; articulation with stipes nearly straight, rounded at base and projecting inwardly beyond inner margin of stipes; strengthened submedially by a corneous band, which is almost continuous with interior margin of stipes. *Mala* (fig. 44) obtuse, bearing a short hastate seta at inner angle and 3 short unci ventrally, on slightly projecting processes of anterior margin; of these one situated at inner angle, the others near middle; in addition, a rounded lobe at outer angle bears a longer and 2 short spinous setae, 3 or 4 minute cuticular spines and a round sensory pit, all near extremity; dorsally mala bears 5 or 6 setae of varying length near anterior margin; inner margin without setae. *Maxillary palp* reaching forwards beyond mala and labial palps; at base a considerable fold of membrane connects maxilla with margin of hypostoma. *Labium* (fig. 43) with bluntly-pointed ligula lying between palps; prementum distinct, the suture between it and postmentum, at base of palpigers. straight; mentum and submentum membranous and not differentiated except by the usual pair of setae on each; articulating areas also membranous, subconical; but their inner margins not reaching to base and must be considered as parts of postmentum. *Gula* membranous and wider than *labium*. *Hypopharynx* with a large, rounded, fleshy lingua extending beneath prementum and capable of being protruded beyond ligula; clothed with minute hairs but not showing any sign of superlinguae; corneous parts consist of a simple transverse bar continued on either side by a ligamentous process extending to articulation of mandible; posteriorly a pair of kneed suspensory apodemes depend from it dorsally, meeting a corresponding pair of processes, which arise from ventral surface of pharynx. *Ventral bay* wide posteriorly, but considerably narrowed in front; the posterior angles rounded and reaching nearly to base of the head; hypostomal ridge not produced beyond angles.

Pronotum (fig. 40) yellow, save for dark spines and 2 small median areas of brown which enclose bases of the 2 pairs of submedian spines; anterior and lateral spines form a palisade round those margins of pronotal plate; the most lateral spine trifurcate, the remainder unbranched; behind anterior row of spines are 2 pairs of very long unbranched spines placed submedianly, as already mentioned. On *meso-* and *metanotum* are single transverse rows of spines only, the median pair of which are unbranched, the intermediate bifurcate and the lateral trifurcate; area surrounding intermediate spine yellow. In abdominal segments 1–8 dorsal scuta brown, save for pale medio-dorsal suture; lateral spines (fig. 45), instead of being trifurcate, have a single main branch and no more than one small minor branch; lateral areas containing spiracles pale. *Pleural plates* of thoracic segments infuscated with brown; those of abdomen pale, except for a rounded fuscous area on each, bearing a short brown spine; these brown areas and spines on them gradually decrease in size towards posterior end; ventral surface of larva pale, with rather deep segmental sutures and the *sterna* strongly transverse, without major setae. *Ninth abdominal segment* short and yellowish (fig. 40); terminal pseudocerci upstanding, brown and pointed, shorter than some of dorsal spines and each with a few minor branches; laterally tergite bears a small spine contained within a patch of brown on either side; this spine probably represents the lateral spine, and the pseudocercus with a short spine at its base, the submedian and intermediate spines of other segments. Ninth sternite lies anterior to tenth segment, which is situated postero-ventrally, beneath base of pseudocerci, and surrounded by a fold of the ninth segment. Proximally *tenth segment* bears 2 round fleshy lobes side by side, representing the sternite; distally there are 2 subtriangular processes, separated a little from one another and each bearing 2 short setae posteriorly; these 2 processes together probably represent the tergite of the segment.

Legs long and placed widely apart; coxae long, with outer side fuscous; femur a little

shorter, yellow; tibia about same length as femur, gently tapered to apex; claw long and bowed, sharply pointed and with a short spine and 2 fine setae near the base.

Spiracles arranged in a row ventral to tergal spines in tergum of mesothorax and of segments 1–8 in abdomen; in mesothorax they lie close to anterior margin. Ventral to each thoracic spiracle and adjoining it, is a small brown spine, bearing a short seta at its apex (fig. 46). All spiracles annular and bearing a narrow brown rim within aperture of each; walls of atrium with numerous short simple hairs on ridges of surface; trachea protrudes into bottom of atrium, where its opening is concealed by concentrically arranged hairs; a closing apparatus is present, at least in the thoracic spiracle, at some distance from the surface, but also at some distance from junction with tracheal trunk; this bears a single lever (fig. 46, *cl*).



FIGS. 47–49.—(47) Larva of *Diphyllus lunatus* F.: right mandible, ventral view (W 2, 6, a); (48–49) Larva of *Helota gemmata* Gorh.: (48) right maxilla, dorsal view (W 2, 3, b); (49) left mandible, ventral view (W 2, 3, b).

The larva of *Homoeotelus confusus* Crotch, a species from Central America, has been figured by Böving and Craighead. This species bears a long pair of filamentous caudal processes and in this respect resembles *Cypherotylus goryi* and *C. boisduvali*; but the presence of multibranched spines on the dorsal plates serves to distinguish it readily from the former and the longer antennae from both these species.

[V. Analytical Keys

A. *The Discrimination between Larval Cryptophagidae and Erotylidae*

1 (2) Labial palpi single-jointed, less often two-jointed, in these cases (Atomariinae) the prostheca of both mandibles bifid, the 2 points

lying dorso-ventrad to each other, not proximo-distad. Less than 5 ocelli. Maxillary mala falciform, dorsal surface always with a longitudinal row of setae along inner margin. Hypopharynx with a pair of anterior submedian horns. Spiracles bicameral or (Atomariinae) annular. Pygopodium bilobed (Atomariinae ?)[3] . . . . . CRYPTOPHAGIDAE

2 (1) Labial palpi two-jointed. Mandibular prostheca ending in a single point or consisting of a group of ribbon-like or spine-like processes (fig. 47) or of a fleshy hairy or asperate lobe, never bifid. Pygopodium bilobed, the 2 lobes sometimes (Helotinae, Diphyllinae) doubled . . . . . EROTYLIDAE

B. *Analytical Key to the Subfamilies and Genera of Larval Erotylidae*

(Genera marked * have not been seen by either A. W. Rymer Roberts or F. I. van Emden.)

1 (20) Maxillary lobe falciform, seldom obliquely truncate with 2 spines at inner more proximal angle; in this case with a dense longitudinal row of fine contiguous cilia in the place of the dorsal longitudinal row of setae along inner margin present in all other forms; when falciform the apex ending in 3 sclerotised spines, which project mediad. Mandible with a well-developed asperate (except in *Teretilanguria*) molar and, between this and apical part, a bare pointed hyaline prostheca (fig. 49, *p*; except in *Teretilanguria*) or a tuft of ribbon-like processes (fig. 47), inner half of base on ventral surface (except in *Teretilanguria*) with a crushing tubercle (fig. 47, *t*). Epipharynx with a row of oblique ridges on each side. Hypopharynx with a pair of submedian anterior horns (fused into 1 median horn in Helotinae). Ligula not or hardly produced at middle, *i.e.* broadly rounded or truncate. Articulating area between labium and maxilla occupied by a secondary sclerite.

2 (19) Maxillary lobe with a dorsal longitudinal row of setae, falcate, the parts corresponding to the inner and outer lobes not defined. Labrum articulating with clypeus.

3 (6) Clypeus separated from frontale by a suture. Prostheca consisting of a tuft of ribbon-like processes (fig. 47, *p*). The 2 lobes of the pygopodium double. Metopic suture short and indistinct. Mandible with 2 apical teeth, cutting edge of the dorsal tooth with 3 strong serrations; asperities of molar (*m*) extending on to inner part of ventral surface. Six ocelli, the sixth small and much farther ventrad, the third (of the front row) about as widely separated from the second as this from the first. First antennal segment very short and strongly transverse, second about as long as wide, third slender, about as long as second. Ninth tergite without tubercles or spines between base and cerci, the latter small, forming a tooth-like spine. (DIPHYLLINAE)[4]

[3] The various species in my collection, belonging to the genera *Antherophagus*, *Cryptophagus* and *Telmatophilus*, have the pygopodium distinctly bilobed.

[4] The larval characters of the following 2 forms can certainly not be considered to be of generic rank, and the distinguishing features of the adults also are of a specific rather than a generic nature.

4 (5) Cerci lying slightly before middle of ninth tergite (measured from anterior keel to hind margin), separated from the posterior keel by less than their basal width. Intersegmental membranes without a row of granules. Posterior keel of tergites somewhat irregularly "jagged" (*D. lunatus* F.) . . . . . **Diphyllus**

5 (4) Cerci lying slightly behind middle of ninth tergite, separated from the posterior keel by somewhat more than their basal width. Intersegmental membranes on dorsal surface with a row of fine transverse granules. Posterior keel of tergites rather evenly crenulated (*D. fagi* Guér.) . . . **Diphyllus** (subgen. *Diplocoelus*)

6 (3) Clypeus fused with frontale. Prostheca consisting of a single and simple pointed triangular hyaline process. The 2 lobes of the pygopodium simple.

7 (12) Ninth tergite between base and cerci with a pair of spines or outstanding tubercles (in addition often to other more lateral tubercles). Disc of tergites with only very short and inconspicuous setae, outer part with some longer setae, all of them more or less blunt. Metopic suture absent. Mandibles with only 2 apical teeth, cutting edge smooth between these and the prostheca; molar asperities extending on to inner part of ventral surface; 5–6 ocelli. (CLADOXENINAE)

8 (9) Granules of the tergites irregularly arranged and distributed over all parts, the 2 longitudinal rows of stronger tubercles towards outer margin, which bear long setae, only moderately prominent; all dorsal setae, even the longest, clavate or somewhat spatulate at tip. Cerci directed caudad, with granules on basal half and some setiferous tubercles near middle, ninth tergite everywhere with conspicuous granules and, in addition to the discal pair, with 2–3 other pairs of setiferous tubercles. Frontale with an endocarina; dorsal surface of head without granulose asperities. Mandible with a hairy appendage at base of cutting edge . . . . . **Pharaxonotha**

9 (8) Granules of the tergites arranged in a transverse line near fore and hind margins, disc with only a few granules and large smooth areas; the lateral part with 2 longitudinal rows of 2–3 strong setiferous tubercles; dorsal setae frayed or blunt but not spatulate or clavate. Cerci upcurved, not granulose, granules of ninth tergite confined to a transverse row at base and some along the emargination between the cerci. Frontale without an endocarina; dorsal surface of head with granulose asperities.

10 (11) The pair of discal processes of the ninth tergite at least as long as the cerci and evenly pointed, somewhat curved backward, not setiferous; cerci with an inner and outer setiferous tubercle near middle of ventral surface; ninth tergite on dorsolateral surface with only 2 setiferous tubercles, the proximal of which is much the stronger. Discal granules of the tergites irregularly arranged. Dorsal setae frayed . . . . . **Platycladoxena**

11 (10) The pair of discal processes of the ninth tergite about a third length of cerci, stout and subcylindrical, apical part abruptly tapering, outer shoulder with a scale-like seta; cerci without an outer, but with 2 large inner setiferous tubercles; dorsolateral surface of ninth tergite with 5 (3 + 2) subequal digitate

processes, each bearing a long and tapering seta. Discal granules of the tergites mostly arranged in longitudinal rows which connect the transverse ones. Dorsal setae more (the shorter ones) or less (the longer ones) blunt . . . . **Hapalips**

12 (7) Ninth tergite between base and cerci without a pair of spines or spiniform tubercles (but in *Teretilanguria* with some scattered ones). Metopic suture present. Mandibles with 3 or 2 apical teeth, in the latter case distal part of cutting edge serrate or with the indication of a third tooth; molar asperities not or hardly extending on to inner part of ventral surface; 0–2 ocelli (LANGURIINAE).

13 (14) Cerci conspicuously bifid, stout with several irregular smaller spines and tubercles; disc of ninth tergite with irregular spinose tubercles; posterior tergites up to the eighth with increasingly stronger and more numerous spinose tubercles. Prostheca and ventral crushing tubercle of mandible absent; apex with 3 teeth; molar not asperate. One conspicuous ocellus . . . . . **Teretilanguria**

14 (13) Cerci ending in a simple point, smooth; disc of ninth tergite smooth like the other tergites. Molar with transverse asperities (*i.e.* striate).

15 (16) Mandible with 3 strong apical teeth.[5] Ocelli absent . . . **Languria**

16 (15) Mandible with 2 strong apical teeth. One well-developed ocellus (in *Dasydactylus* possibly a small second ocellus present).

17 (18) Cutting edge of mandible serrate basad of the apical teeth **Coenolanguria**

18 (17) Cutting edge of mandible with a slight knob basad of the apical teeth, which represents the vestige of a third tooth . **Dasydactylus**

19 (2) Maxillary lobe (fig. 48) with a dorsal fringe (*f*) of dense contiguous fine cilia over its whole length, obtuse, the parts corresponding to the inner and outer lobes separated by a membranous band. Labrum fused with clypeus, except laterally; clypeus fused with frons. Pygopodium with a pair of bilobed processes. Metopic suture absent. Mandible (fig. 49) with a well-developed molar (*m*) which is asperate on inner surface and inner part of ventral surface, with a ventral crushing tubercle (*t*) on inner half of base and a spiniform hyaline prostheca (*p*); apex with 2 teeth and, just basad of them, a few denticules. Maxillary lobe obliquely truncate, but inner (proximal) apical angle produced into 2 somewhat curved spines (*s*). Ligula hardly produced. Articulating area between maxilla and labium with a secondary sclerite (fig. 48, *sc*). Five ocelli, the most ventral one somewhat more widely separated from the rest than these from one another; in addition a very small sixth ocellus behind the ventral one. Spiracles annular-bicameral. Epipleurites produced into a process adorned with some setiferous tubercles. Cerci long, pointed and with setiferous tubercles, some of these near base spiniform; ninth tergite with 3 small pits but without setiferous tubercles (HELOTINAE; *H. gemmata* Gorh.) . . . . . **Helota**

[5] According to some sketches sent by Dr. A. G. Böving to the late A. W. Rymer Roberts the mandible of *Acropteroxys lecontei* Crotch differs by the presence of 3–4 serrations on the cutting edge basad of the 3 strong apical teeth. There is no information on the ocelli, cerci, etc.

20 (1) Maxillary lobe obtuse, apex usually produced into some spines in addition to spiniform (articulating) setae, but these spines not pointing mediad, except to some extent in *Dacne* (without a metopic suture but with 3 apical mandibular teeth); without a dorsal fringe of cilia near inner margin, but sometimes with a dorsal longitudinal row of setae; 5–6 ocelli, 4 of them forming a group behind the antenna, the fifth placed more ventrally and the sixth, where present, behind the fifth. Mandible with 3 apical teeth. Pygopodium bilobed.

21 (26) Maxillary lobe with a dorsal longitudinal row of setae along margin. Cerci pointed and recurved, basal part with setiferous tubercles.

22 (25) Dorsal surface of head with well-developed granulose asperities. Ligula not or hardly produced, very broadly rounded or truncate. Articulating area between maxilla and labium with an oblong secondary sclerite. (DACNINAE)

23 (24) Tergites wholly pale, ninth, in addition to numerous granules, with a transverse row of 3 *pairs* of setiferous tubercles, the intermediate one being the largest. Length 4–5 mm. Metopic suture absent, frontal sutures obsolete; endocarina absent. Epipharynx with a row of oblique ridges on each side; hypopharynx with a pair of anterior horns. Mandible with a well-developed molar with striate asperities, a pointed prostheca, and a ventral crushing tubercle. Apical margin of maxillary lobe divided into an inner part carrying 3 spines and a rounded outer part carrying spiniform setae . . . . . **Dacne**

24 (23) Tergites brown, with numerous tubercles and pointed granules of various sizes, the former bearing short setulae, ninth *irregularly* granulate and tuberculate. Much larger. Metopic suture distinct, frontal sutures visible near base; endocarina present.[6] Epipharynx without oblique ridges; hypopharynx without anterior horns. Mandible somewhat produced at base but without a distinct molar and without molar asperities; prostheca fleshy, broadly rounded, finely haired; ventral crushing tubercle absent. Apex of maxillary lobe divided by a notch, inner part with 2–3 stout spurs, outer part with 1 blunt tooth . . . . . **Megalodacne**

25 (22) Dorsal surface of head without granulose asperities. Ligula produced and narrowly rounded. Articulating area between maxilla and labium not sclerotised. Epipharynx apparently without oblique ridges; hypopharynx apparently without sclerotisations. Metopic suture distinct. Mandible with 3 apical teeth, the third, however, very small; base somewhat dilated interiorly but without a distinct molar and without molar asperities or a ventral crushing tubercle; prostheca consisting of 3–4 spines arranged in a close longitudinal row. Maxillary lobe not notched at apex, with a dense tuft of cilia at base of outer part (close to and above the palpi). Spiracles bicameral. Dorsal surface of tergites without granules, only with a transverse row of 6 low transversely-oblong tubercles on

[6] The larva of the genus *Episcapha* described by Nobuchi (1955, *Kontyû* 23 : 57, pl. 9, figs. 20–22, 24, 25, 27, 29, 30) is obviously very closely related, but the mandibular characters are unknown. It differs by longer cerci with numerous setiferous branches and the tergites bearing conspicuous setiferous tubercles and short processes.

anterior part; ninth tergite with 2 pairs of setiferous tubercles between base of cerci and front margin, otherwise smooth; cerci short and pointed as in *Triplax*, with a setiferous tubercle at base of both exterior and posterior surfaces (TETRATOMINAE; *T. fungorum* F.) . . . . . **Tetratoma**[7]

26 (21) Maxillary lobe without a dorsal longitudinal row of setae along inner margin.[8] Ligula conspicuously produced and strongly rounded. Articulating area between maxilla and labium without a sclerite. Metopic suture absent; endocarina absent. Mandible with a broad fleshy prostheca, which is asperate by minute hairs or tubercles or more or less strong spines, often appearing like a molar; molar absent or vestigial, apparently always without asperities; ventral crushing tubercle absent. Epipharynx without oblique ridges; hypopharynx without anterior horns.

27 (38) Spiracles annular. Antennae long,[9] especially the second segment; its appendage more or less short, up to a third the length of the third segment. Cerci sometimes filamentous. (EROTYLINAE, Erotylini)

28 (31) Posterior trochantini with a conspicuous spine at least on posterior part. Tergites with not more than 2 long and 1 small spine on each side. Epipleurites with a long spine. Antennae much shorter than width of head. Cerci filamentous, longer than 4–5 abdominal segments, with small tubercles.

29 (30) Tergites with only the paramedian spine more (in younger larvae) or less (in full-grown larvae) strong, the outer 2 vestigial. Fore trochantinus with a strong spine on both anterior and posterior parts, all spines of the trochantini simple. Dorsal surface of head with only a few pairs of small tubercles . . **Cypherotylus**

[7] As adults the Tetratominae are normally placed in the Melandryidae, though Crowson (1956, *Handb. Ident. Brit. Ins.* 4 (1) : 41) has recently given them family rank, possibly influenced by the deviating characters of the larvae (van Emden, 1942, *Ent. mon. Mag.* **78** : 258). I am not able at present to modify the larval classification of the two families offered in 1942. Larvae of *Penthe* are not available, but from Böving and Craighead's (1931) figures it appears probable that they are related to those of *Tetratoma*, with which genus the adult is classified.

[8] In *Aulacochilus* (described by Nobuchi, 1954, *Kontyû* **22** : 3, pl. 1, figs. 1*a*, 2*a*, 3*a*, *b*, 4*a*, *b*, 6*a*, *b*), which belongs to Erotylinae Encaustini, the larval maxilla bears on apical part of ventral surface a large claw-like toothed appendage similar to that of *Megalodacne* (see above fig. 7), which seems to distinguish the genus from all the Erotylinae and Triplacinae studied by Rymer Roberts and Böving. The cerci are fused at base and have each a ventral and a lateral setiferous tubercle. The second antennal segment is somewhat longer than wide but less than twice as long as wide. The structure of the spiracles is unknown, but the shortness of the second antennal segment separates the genus from Erotylinae Erotylini. The epipleurites and hypopleurites seem to form short subconical processes. A species from Sumatra in the British Museum (Natural History) has annular spiracles, the second antennal segment about twice as long as wide (and the whole antenna only as long as one-sixth of the head width), the inner spine of the maxillary lobe claw-like with a smaller one at its base, and the cerci fused for a short distance at base. It thus appears to be closely related to Nobuchi's *Aulacochilus* larva and may belong to the same genus. Therefore, the larva described by Nobuchi may be assumed to have annular spiracles. The Encaustini would then have to be classified with the Erotylinae like their adults, a distinguishing character being the shorter antenna and especially its second segment, another the claw-like inner spine of the maxillary lobe.

[9] See note[8] [ad par. 26].

30 (29) Tergites with the paramedian and lateral spines strong and the intermediate one small. Fore trochantinus with a forked spine on posterior part, anterior part only produced into a tooth, posterior trochantini with a strong forked spine on posterior part. Dorsal surface of head with 2 pairs of strong spines behind and a few smaller ones in front of them (gen. et sp. indet., Brazil: Sta. Catharina) . . . . . **Erotylus** ??

31 (28) Trochantini without, or with 1 or several small, spines or with a tubercle in their place. Cerci not or hardly longer than the spines of the posterior tergites, about as long as 2 abdominal segments or shorter (but in *Homoeotelus confusus* as in *Cypherotylus*).

32 (35) Dorsal abdominal spines long and slender, not forked or with only 1–4 short pointed branches.

33 (34) Spines of the epipleurites subequal to the tergal spines on anterior abdominal segments. Antenna about half as long as width of head. Head with 2 pairs of strong spines in a transverse row behind and with 1 pair of small ones on the frontale in front of them . . . . . **Coccimorphus***

34 (33) Spines of the epipleurites several times shorter than tergal spines, almost tooth-like (but in *H. confusus* subequal to the tergal spines). Antennae conspicuously longer than width of head. Head with a transverse row of 2 pairs of slender setiferous spines behind . . . . . **Homoeotelus**[10]

35 (32) Dorsal abdominal spines stout with numerous branches which are much longer than the spines and conspicuously barbed. Posterior part of trochantini with 1–2 tubercles or a setiferous spine.

36 (37) Spines of the tergites terminating in several long filamentous branches. Antennae up to about half as long as head-width. Spines of the anterior epipleurites several times as long as wide, not much shorter than those of the tergites (*meridionalis* Crotch and *quadrinotatus* Chevr.), or thin and about as long as the trunk of those of the tergites with several smaller ones arising at their base, the basal tubercle in reality corresponding to the trunk of the dorsal spines ("*Aegithus guadelupensis* F." in the British Museum (Natural History))[11]. Head with short setiferous slender spines or tubercles arranged in a posterior row of 2 pairs and several pairs in front of this row (*mer.* and *quadr.*) or without spines and tubercles (*guad.*) . . . . . **Aegithus**

37 (36) Spines of the tergites suddenly tapering into a single terminal filament. Antennae almost as long as head width. Spines of the epipleurites not or hardly longer than wide, much shorter

[10] The larva of *H. confusus* Crotch, figured by Böving and Craighead (1931, pl. 41, fig. D), differs strongly from that of *H. gemellatus* of our material (see p. 272) and shows features of the three genera *Homoeotelus*, *Coccimorphus* and *Cypherotylus*. As long as only one or two species of each of these genera are known in the larval stage, it is difficult to judge the importance of the various characters, and it is also quite possible that the grouping of the adults requires some revision.

[11] The Schenkling Catalogue lists a synonym *guadeloupensis* F. of *Brachysphaenus marginatus* Oliv., and adults found with these larvae have been named *Brachysphaenus guadeloupensis* F. by the late G. J. Arrow. The above species is to some extent intermediate between this genus and *Aegithus*, which as adults are separated only by a somewhat different shape of the body.

than those of the tergites. Head with a transverse row of 2 pairs of slender setiferous spines behind and a smaller pair in front of this row (*B. signatus* Dup.) . . . . . **Brachysphaenus**

38 (27) Spiracles bicameral. Antennae usually rather short, appendage of second segment proportionately longer. Cerci hook-like, rather short (but see *Ischyrus*), or absent. (TRIPLACINAE)

39 (40) Cerci absent. Body onisciform, pronotum with 4, meso- and metanotum with 2, tergites with 1 lobiform process on each side, which are directed laterad and backward. Dorsal sclerites without granules and tubercles. Second antennal segment long, about 4–5 times as long as wide. Mandibular teeth serrate. Air-chambers of spiracles short, hardly projecting beyond peritreme (*L. rufinus* Lac.; according to sketches by Dr. A. G. Böving) . . . . . **Lybas***

40 (39) Cerci present, simple and short.[12]. Body subcylindrical to spindle-shaped, tergites without lateral processes. Second antennal segment shorter, up to about 3 times as long as wide.

41 (42) Inner margin of maxillary lobe strongly bent mediad at base, the lobe thus appearing shifted mediad basally and straightened up again at an angle of about 110°. Second antennal segment much wider than long. Head apparently without cuticular granules (*N. lewisi* Crotch; Nobuchi, 1954, *Kontyû* **22** : 4, pl. 1, figs. 1*c*, 2*c*, 3*c*, 4*c*, 5*c*, 6*c*) . . . . . **Neotriplax***

42 (41) Inner margin of maxilla more or less straight.

43 (44) Head without cuticular granules or tubercles. Ninth tergite with a few short pointed setiferous granules, which are not arranged in definite transverse rows. Prostheca distally with a prominent digitate projection, the proximal part spinose; the 2 larger apical teeth of the mandible coarsely serrate. Nota and tergites 1–8 with rather dense small granules and 2 transverse rows of 5 pairs of setiferous tubercles, the outer 2 tubercles on a common callosity which extends to both rows and which is defined interiorly by a small pit, the tubercles more conspicuous and more pointed in older larvae and on posterior tergites **Amblyopus**

44 (43) Head with cuticular granules or tubercles. Prostheca without a digitate spinose apical projection. Apical teeth of mandible finely serrate or smooth.

45 (46) Frontale suddenly strongly narrowed some distance before it reaches hind margin of head, and only the median part extending as a narrow tongue to hind margin. Ligula broad and broadly rounded. Second antennal segment less than twice as long as wide, not much longer than first. Air-tubes of spiracles not much longer than width of peritreme. Apex of maxillary lobe with 3 strong teeth, the innermost of which is rather widely separated from the other 2 (*P. nigropunctatus* Perch.; according to sketches by Dr. A. G. Böving) . . . . . **Pselaphacus***

[12] *Microsternus perforatus* Lewis, the adult of which is classified in Dacninae, and the larva of which has been described by Nobuchi (1955, *Kontyû* **23** : 56, pl. 8, figs. 23, 26, 28) has apparently no longitudinal dorsal row of setae on the maxillary lobe and will presumably be traced to the present couplet. It differs in the cerci which are fused into a conical process which bears numerous small setiferous tubercles and the apex of which ends in a spiniformdorsal and a shorter and blunter ventral prominence. Second antennal segment not longer than wide.

46 (45) Frontale broadly rounded or truncate behind, broadly reaching hind margin of head or (*Ischyrus flavitarsis*) separated from hind margin by a short metopic suture. Ligula narrowly rounded.

47 (50) Second antennal segment almost or fully twice as long as wide. Maxillary lobe at inner end of apex with 3 conspicuous spiniform teeth which are closely approximated and longer than wide; outer part rather strongly separated from inner part by a deep incision and about as far projecting as inner part. Middle apical tooth of mandible rather conspicuously serrate. Air-tubes of spiracles moderately long, projecting beyond peritreme.

48 (49) Base of mandible without an appendage. Apex of maxilla obliquely truncate; cardo about half as long as rest of maxilla. Ocelli situated on conspicuous tubercles, some adjacent tubercles not, or not much, less prominent. Cerci more than twice as long as wide at base, sometimes (*flavitarsis*) fused for some distance at base and about as long as last 3 abdominal segments. Tergites with numerous strong setiferous tubercles, most of which are longer than wide. Spiracles situated in the membrane (*quadripunctatus*) or on special small sclerites (*flav.*). These and coxae and trochantini adorned with small sharp curved spines (*flav.*), or these spines absent (*quadr.*) (*I. flavitarsis* Lac. and *quadripunctatus* Ol., both apparently not bred) . . . . **Ischyrus**

49 (48) Base of mandible with an appendage beset with papillae. Apex of maxilla truncate at right angles; cardo about one-third as long as rest of maxilla (*O. violaceus* Sturm; according to sketches by Dr. A. G. Böving) . . . . . **Oocyanus***

50 (47) Second antennal segment up to about as long as wide. Maxillary lobe at inner end of apex with not more than one spiniform tooth, seldom (in *Tritoma pulchrum* Say, according to sketches by Dr. A. G. Böving) in addition with 2–3 teeth, but these are short and not close to inner end of apex. Apical teeth of mandible smooth or very finely serrate. Dorsal sclerites with granulose asperities.

51 (52) Setiferous tubercles anterior to base of cerci not or hardly stronger than the granules, ninth tergite almost evenly granulate like the other tergites . . . . . **Tritoma**

52 (51) Two pairs of setiferous tubercles anterior to base of cerci strong, the other tergites also with more (posterior tergites) or less (anterior tergites) conspicuous paired tubercles in addition to the granules . . . . . **Triplax]**

VI. References

Arrow, G. J., 1925, *Fauna of British India. Coleoptera : Erotylidae, Languriidae and Endomychidae.* London.

—— 1929, On the families of Coleoptera related to the Erotylidae. *Ann. Mag. nat. Hist.* (10) **4** : 305–22.

Bedel, L., 1868, Monographie des Erotyliens (Engides et Triplacides) d'Europe, etc. *Abeille* **5** : 1–50 (p. 5).

Böving, A. G. and Craighead, F. C., 1931, An illustrated synopsis of the principal larval forms of the order Coleoptera. *Ent. Amer.* (n.s.) **11** : 1–351.

Candèze, E., 1861, Histoire des métamorphoses de quelques Coléoptères exotiques. *Mém. Soc. Sci. Liège* **16** : 325–410.
Crotch, G. R., 1873, Synopsis of the Erotylidae of Boreal America. *Trans. Amer. ent. Soc.* **4** : 349–58.
Dufour, L., 1842, Histoire des métamorphoses du *Triplax nigripennis*. *Ann. Soc. ent. Fr.* **11** : 191–96.
Fukuda, A., 1943, Larva of *Helota gemmata* Gorham. *Trans. nat. Hist. Soc. Formosa* **33** : 15–18.
—— 1951, *In* Kano, R., *et al.*, *Illustrated Pocket Book of Insect Larvae*. Tokyo (p. 168).
Ganglbauer, L., 1899, *Die Käfer von Mitteleuropa* **3**. Vienna.
Handlirsch, A., 1925, Systematische Uebersicht. *In* Schröder, C., *Handbuch der Entomologie* **3** : 377–1143 (pp. 600–3).
Kuhnt, P., 1909, Erotylidae. Wytsman, P., *Genera Insectorum*, fasc. **88**. Brussels.
Lamprecht, H., 1924, Zur Biologie von *Dacne bipustulata* Thunbg. *Ent. Tidskr.* **45** : 83–89.
Niimura, T., 1939, On four species of Japanese Erotylidae. *Bot. Zool.*, Tokyo **7** : 1063–7, figs. 1–4.
Nobuchi, A., 1954–55, Morphological and ecological notes of fungivorous insects. II. On the larvae of Erotylid beetles from Japan. *Kontyû* **22** : 1–6, pl. 1 ; **23** : 53–60, pls. 8, 9.
Roberts, A. W. Rymer, 1939, On the taxonomy of Erotylidae (Coleoptera), with special reference to the morphological characters of the larvae. *Trans. R. ent. Soc. Lond.* **88** : 89–118.
Seidlitz, G. v., 1887–91, *Fauna Baltica*. Ed. II, p. 63. Königsberg.
Sharp, D. and Muir, F., 1912, The comparative anatomy of the male genital tube in Coleoptera. *Trans. ent. Soc. Lond.* **1912** : 477–642.
Verhoeff, C., 1895, Vergleichend-morphologische Untersuchungen über das Abdomen der Endomychiden, Erotyliden und Languriiden, etc. *Arch. Natgesch.* **61** : 213–87, pls. XII, XIII.
Westwood, J. O., 1839, *An introduction to the modern classification of insects*, etc. **1** : 143–8, and *Synopsis* : 12–13. London.

VII. Notes on the Figures, with Explanation of Lettering

With the exception of numbers 24, 32 and 40, the figures have been made with the aid of a camera lucida. A Leitz (" L ") or Winkel (" W ") microscope has been used. The first number after the microscope make represents the eye-piece, the second the objective used (*e.g.* L 2, 6 indicates a Leitz eye-piece 2 with a Leitz objective 6). The letter after the objective refers to the scale drawn to the same enlargement. These scales show parts of a millimetre.

aa, articulating area.
am, articulating membrane.
ap, rim of aperture.
app, appendage of second segment.
at, atrium.
Br, hypopharyngeal bracon.
ch, chambers.
cl, closing lever.
cs, conical seta, corresponding to that in Languriinae.
d, dorsal ginglymus.
de, dorsal end.
dp, digitate projection of prostheca.
dt, dorsal tooth.
f, fringe of mala.
ir, inner rim.
l, lobe.
lg, ligula.
li, lingua.
lip, lip.

lrm, labial retractor muscles.
m, molar.
mu, adductor muscle.
o, opening of peritreme of spiracle.
oc, ocelli.
op, outer process.
p, prostheca.
ps, pseudomola.
pt, peritreme.
rp, rounded process.
S, spine at inner tip of mala.
SA, suspensory apodeme.
Sc or SC, sclerite of articulating area.
sl or SL, superlingua (?).
st, strut of cardo.
t, ventral crushing tubercle (to which adductor muscle is attached).
tb, trabeculae.
v, ventral condylus.
ve, ventral end.
vt, ventral tooth.